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PLANTS & GARDENS

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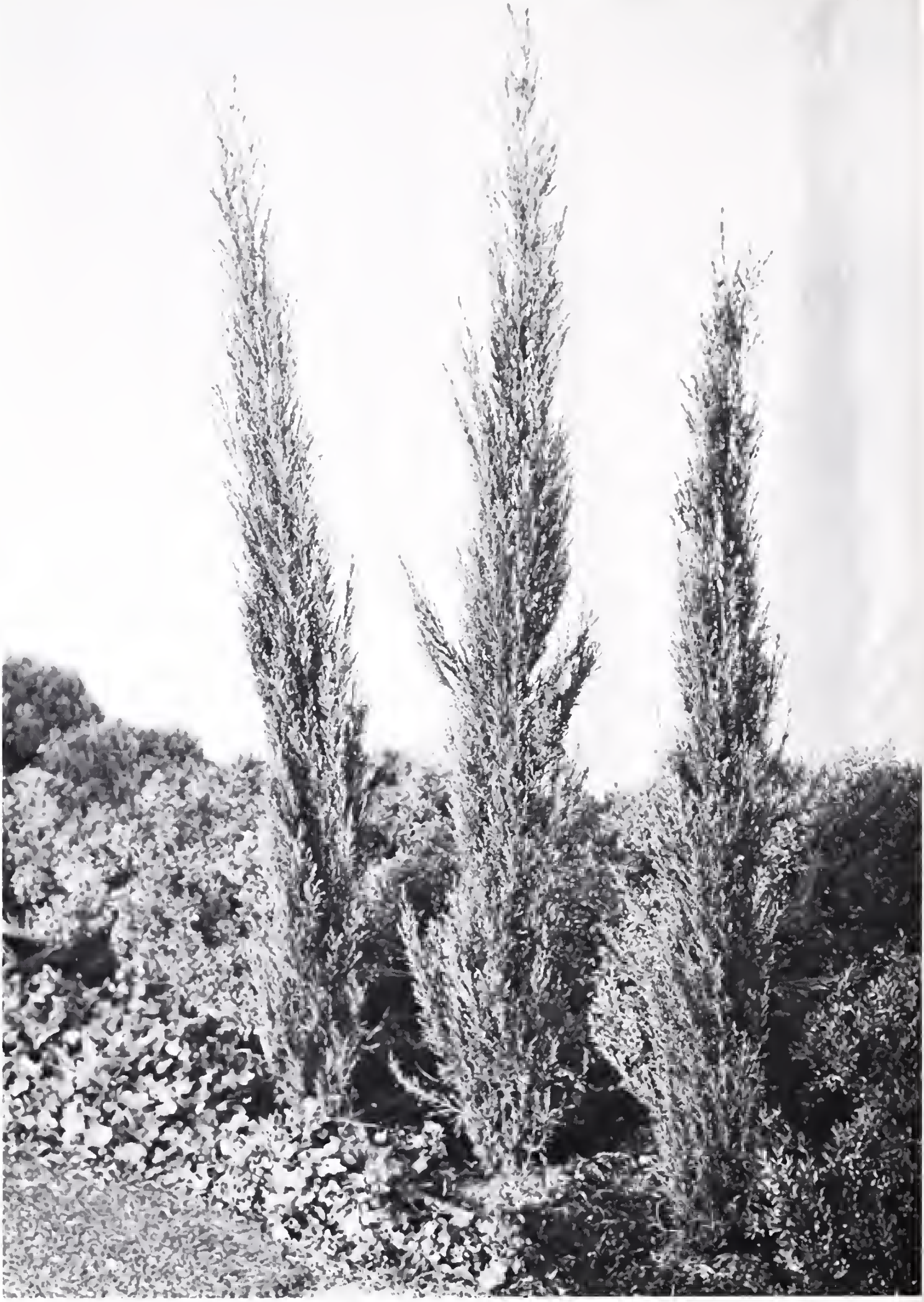


Longwood Gardens Photograph

The tall, densely columnar form of a Chinese juniper (*Juniperus chinensis* 'Mas') at Longwood Gardens, Kennett Square, Pennsylvania. The Chinese juniper is a variable species offering many forms suitable for a variety of landscaping situations.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

The keen home grower, the plant collector and even the botanic gardener are apt to regard plants as individual units—to be admired strictly for their own traits. Every so often, gardens may be rich in treasures of the horticultural world but fail to look their best because the plants bear little relation to the whole. However, as landscape architects well know, plants can have a synergistic action—that is, when they are used together in a pleasing design that takes into account the architecture of the house, topography and dimensions of property, their total effect is greater than if they are treated as independent objects. Guest Editor Clarence E. Lewis, one of America's leading students of trees, shares this larger view, as do the other contributors to this Handbook. They are artists whose working materials are plants.

The silhouette or form of a tree is important in all seasons, but, in cold climates, particularly so in winter, when the strength of nature's design is most apparent. Some widely planted trees, lacking in trunk or twig interest, are but skeletons in the cold months. They are visual "dead weight" in the landscape and make winter seem longer than it is. Other trees have so much character that the eye keeps returning to them with delight. One of the pleasures of winter at the Brooklyn Botanic Garden is a group of old carmine crabapples (*Malus atrosanguinea*) that were left unpruned for many years, then modestly shaped to stress their sturdy but gnarled trunks and nearly horizontal branches. The flowers of these trees are attractive for seven or ten days in spring, but regular visitors to the Garden would not mind if they were never to flower.

There is one special point to consider about tree forms when building a new home or renovating old grounds. When possible, try to conserve at least a few of the existing trees if they have any grace at all. The greatest character of a tree comes with age, and the surrounding flora, or parts of it, will in many cases offer more to the eye than a "new" and carbon-copied planting of garden yews and spireas.

The Editorial Committee
of the Brooklyn Botanic Garden

"The choice of what form—not what plant—is best for a situation should be the first thought."

INTRODUCTION

Clarence E. Lewis, *Guest Editor*

PLANT forms or silhouettes in the landscape can make the overall picture a more pleasing one, or they can be so abrupt that they stand alone with no relationship to the surroundings.

Man strives to imitate nature, and sometimes he does a reasonably good job of it, but too often there is the temptation to try to improve an already restful view or natural garden. Plants—tools of the trade to a landscape architect or designer—are alive and growing; sometimes he forgets this. As the plants grow and age, they change in form and habit. The landscape architect must plan ahead, not just ten or fifteen years but, in some instances, fifty or more.

Some landscapes are planned for a short time, others seem as though they are forever. The small home grounds, in part, can be for a short duration, while the park and roadside may be for several generations. The forms, and their eventual transitions, determine the success or failure of this adventure. Flowers, fruits and autumn color are with us for short periods of time and should only be a part of your consideration when selecting trees.

The choice of what form is best for a situation should be the first thought, not what plant. When this is determined, then one should review all the plants from which one may choose. The list can become quite extensive. From this list one can then decide which plant has the ideal texture, the best depth of green, the correct flowering time, the most persistent fruit, or the best autumn color. Eventually there results a selection of the best and most reliable plants in each form category and so the problem becomes less complicated.

To list all the shapes and forms assumed by woody plants in this issue of PLANTS & GARDENS is not the purpose; rather, it is to bring to your attention the importance of plant forms and their relationships to other plants, buildings, space, curves in the road, walks, and other features of the landscape. My descriptions and examples of some basic forms are given on the next five pages.

TERMS USED BY LANDSCAPE ARCHITECTS

Base plane. Refers to the surface which people walk on. It might be elevated in some instances and lowered in others.

Overhead plane. Horizontal surface, real or imagined, located more than head height above the ground plane.

Landscape materials. Shrubs, trees, vines and ground covers are all landscape materials. Sometimes they are called plant materials, the latter term being more easily applied.

Form. The silhouette, shape or outline created by a plant. Examples: it may be in the shape of a column, ball, pyramid or mound.

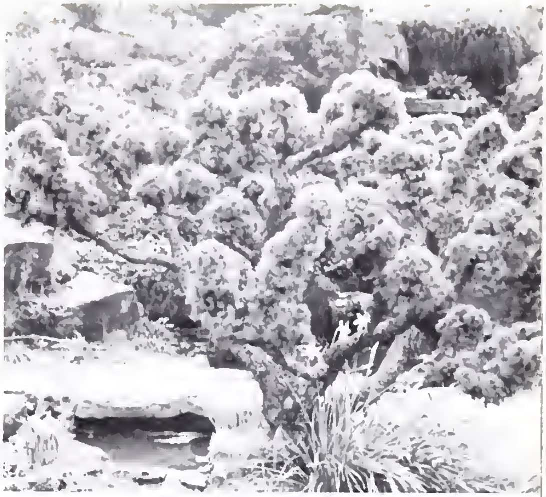
Space. This is a relative term but it is usually the open areas that are used in conjunction with trees and shrubs. Space may be horizontal or vertical but it relates to buildings, hedges, trees, or other landscape features.

Definition (of space, a path, etc.). In landscaping, distinctiveness of design achieved through visual limitation of boundaries.

Man-made Forms

Man-made forms are simply those that have been pruned or trimmed to desired shapes. They may have a prominent geometrical pattern, as in the case of espaliered trees and shrubs, or have whimsical shapes, like certain topiary subjects. Some, such as the artificially dwarfed Japanese larch (*Larix leptolepis*) growing in the Royal Horticultural Society's garden at Wisley, England, may have a club-like growth. Ideally, each plant should have a special character caused by twisted or curved branches, uneven distribution of foliage, accentuation of the already present weeping or upright habit of particular trees, or a pronounced arrangement of the tiers of branches.

Sometimes a tree grows just as we would like to have it! For example, the slow-growing bristlecone pine (*Pinus aristata*) has branches that occur in a sort of whip-like formation that defies description.



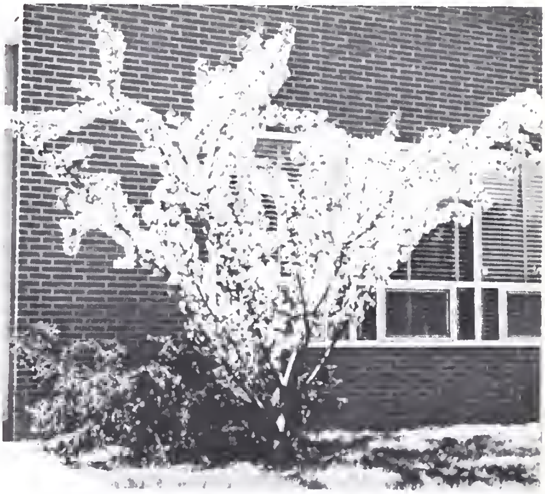
Royal Horticultural Society

Japanese larch (*Larix leptolepis, formerly known as L. kaempferi*), growing in the Royal Horticultural Society's garden, Wisley, is an example of a man-made form as it exists here.

Vase-like Trees

Graceful—and perhaps picturesque—but especially known for its vase shape is the American elm, which we can unfortunately no longer plant for permanency because of Dutch elm disease. However, a small tree of similar habit is tea crabapple (*Malus hupehensis*). It retains its vase form even as a mature tree . Another elm that ought to be mentioned is the true Chinese or littleleaf elm (*Ulmus parvifolia*). It is resistant to elm disease and often has a most attractive mottled bark and vase or v-like habit. 'Dorothea' crabapple (*Malus x* 'Dorothea') has a broad or open vase habit with a rounded instead of open crown.

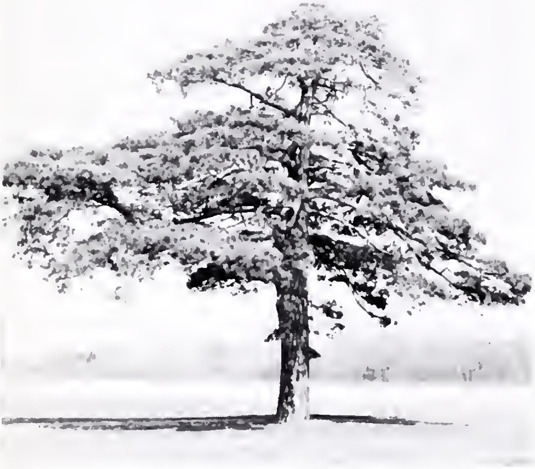
Scholar or pagoda tree (*Sophora japonica*) and a recent introduction of it, 'Regent,' have a form not too unlike that of American elm. The same might be said of Japanese zelkova (*Zelkova serrata*) and one of its selections, 'Village Green.'



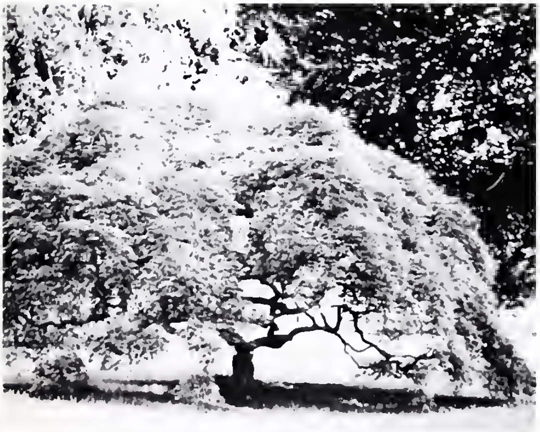
All other photographs by Clarence E. Lewis

The tea crabapple (*Malus hupehensis*) retains its vase-like form into maturity.

(Continued)



An aged Scots pine shows picturesque form, a characteristic of this species.



The thread-leaf Japanese maple (*Acer palmatum* 'Dissectum') matures slowly into a mound shape, usually broader than tall.

Picturesque Forms

The picturesque tree will have varying meanings because different eyes see different pictures, but it should always have grace and distinctive character. It need not always be broad with branches of irregular lengths, but this might be a good point to keep in mind. Nikko fir (*Abies homolepis*) has such strong crotches that it is able to hold its branches at graceful curved extremes. Moreover, the foliage is a rich green, accentuated by the white undersides of the needles. A curved trunk also adds to this conifer's attractiveness.

Other trees with a similar structure are Japanese black pine (*Pinus thunbergii*), especially when grown along the coast, Scots pine (*P. sylvestris*) as it approaches maturity and, frequently, eastern white pine (*P. strobus*). Japanese white pine (*P. parviflora*) has sufficient character to please anyone, as does black or sour gum (*Nyssa sylvatica*) when the terminal leader is lacking, and many hawthorns, such as dotted (*Crataegus punctata*) and cockspur (*C. crus-galli*). Other trees with picturesque "architecture": flowering dogwood (*Cornus florida*), pagoda dogwood (*C. alternifolia*) and Japanese snowbell (*Styrax japonica*).

Mound-like Trees

The thread-leaf Japanese maple (*Acer palmatum* 'Dissectum') with its delicate mound-like appearance takes many years to attain mature form, but it is well worth waiting for—and it is most interesting to watch a specimen develop. The inner part of this small tree has a twisted, gracefully curved branch structure. Other Japanese maples may develop in a similar manner.

Two crabapples in this category are the carmine crabapple (*Malus* x *atrosanguinea*), whose rough branches curve laterally to give a feeling of ruggedness, and the Arnold crabapple (*M.* x *arnoldiana*).

The "Chunky" Forms

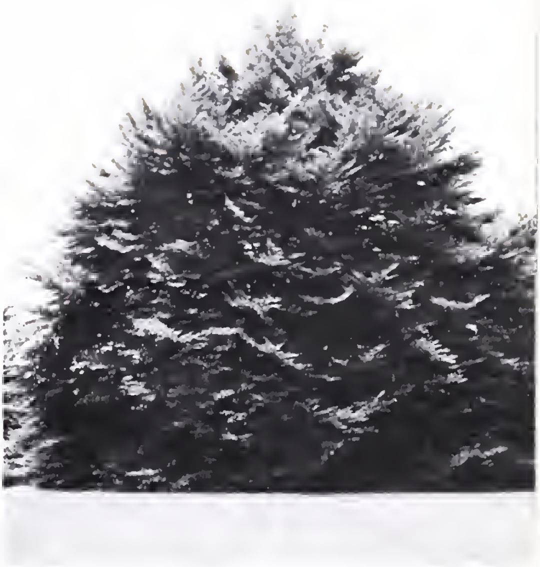
I like to call some shrubs and trees "chunky." Their branches are bunched and the needles or leaves are tightly grouped from top to bottom. Typical evergreen kinds are the Gregory Norway spruce (*Picea abies* 'Gregoryana') and the dwarf Alberta spruce (*P. glauca* 'Conica'). Edging box (*Buxus sempervirens* 'Suffruticosa') also has this character.

Chunky shrubs have formality—yet they are not formal. You can use one as a single specimen without its distracting too much from its surroundings. Sometimes it may even appear to be more than one plant.

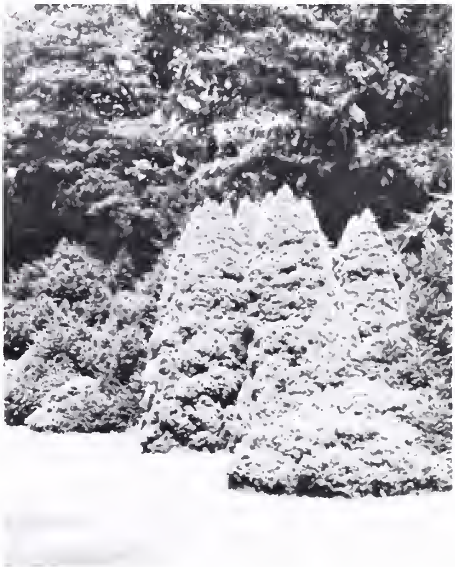
Pyramidal Forms

Pyramidal forms are many and varied. Probably the best known is the pin oak (*Quercus palustris*), of which there has recently been an excellent introduction, 'Sovereign.' The advantage of this recent selection is that its lower branches do not droop like those of a typical pin oak—in fact, they are semi-upright, making it a better street tree. When considering pyramidal forms, do not overlook the American sweet gum (*Liquidambar styraciflua*) and the fine introductions of it made by the Saratoga Horticultural Foundation of California ('Burgundy,' 'Palo Alto'). The list includes many conifers like Nordmann fir (*Abies nordmanniana*) and several kinds of spruce, particularly Norway (*Picea abies*) and Serbian (*P. omorika.*)

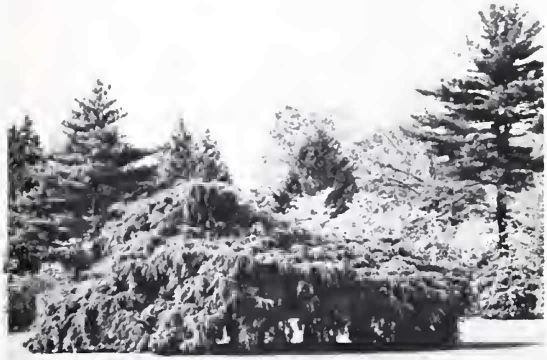
The younger branches of some pyramidal forms also have a weeping tendency. This is true of many spruce trees, also deodar cedar (*Cedrus deodara*) and the most unusual weeping Nootka false-cypress (*Chamaecyparis nootkatensis 'Pendula'*), whose bluish color from a distance creates a misty effect. Many pyramidal trees are relatively broad in relation to their height, among them the highly desirable fern-leaved European beech (*Fagus sylvatica* 'Asplenifolia') and silver linden.



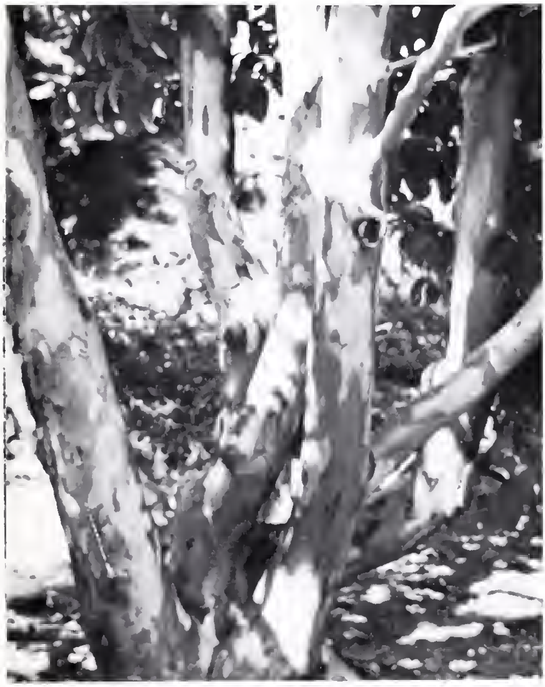
The fern-leaf beech (*Fagus sylvatica* 'Asplenifolia') forms a very broad pyramid.



"Chunky" as well as pyramidal in form is the dwarf Alberta spruce (*Picea glauca* 'Conica') shown here in a massed group.



The Sargent hemlock (*Tsuga canadensis* 'Pendula') is a well-known example of a plant with a weeping form.



Korean stewartia (*Stewartia koreana*) is usually multi-stemmed in habit. An asset is the flaking cream and brown bark.

Weeping Trees

The numerous weeping forms are of different shapes and sizes. One of the most interesting is Sargent hemlock (*Tsuga canadensis* 'Pendula'). Even a young plant can be a magnificent specimen. The fine texture of its needles adds grace and beauty.

Another excellent form is the weeping beech (*Fagus sylvatica* 'Pendula'), which becomes a large tree of considerable spread after many years. There is a weeping purple-leaved selection, too. The list could be extensive, for there are many kinds of desirable trees with this habit of growth. 'Red Jade' crabapple (*Malus* x 'Red Jade') can be trained to have a tall weeping leader, which makes this small tree unusually attractive. Weeping willows, of course, are well known examples. Young's European birch (*Betula pendula* 'Youngii), with its curved trunk, has noteworthy character even in winter. Teas mulberry (*Morus alba* 'Pendula'), because of its fast growth, should be considered and, justly so, two others—weeping scholar or pagoda tree (*Sophora japonica* 'Pendula') and weeping silver linden (*Tilia petiolaris*). The latter becomes a large tree in time.

Multiple-stemmed Trees

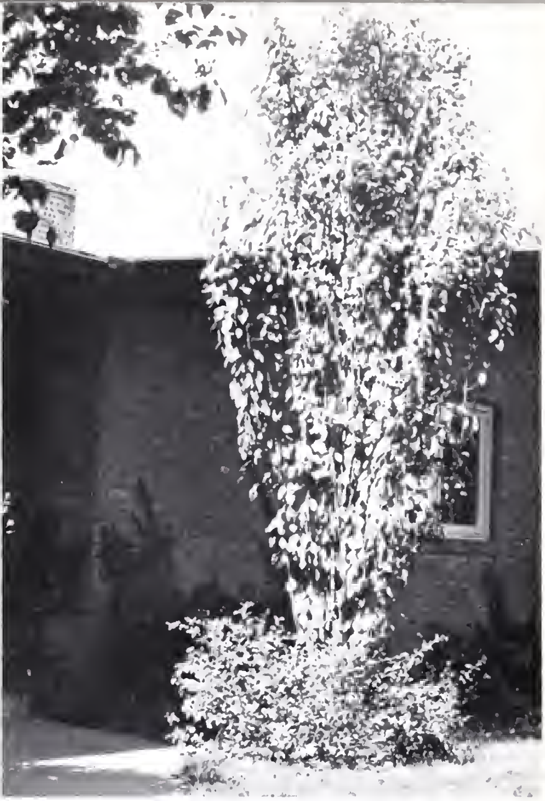
The multiple-stemmed or clump-growing tree can be an important part of the landscape. This is especially true if its bark is attractive, as on the white-barked birches. Others of note: American hornbeam (*Carpinus caroliniana*), which has smooth, strong, muscular-appearing gray bark; Amur maple (*Acer ginnala*); and, possibly, the quick-growing Japanese red pine (*Pinus densiflora*), which may have an orange-tinted bark.

Greater "ground weight" is apparent with several stems rather than one. This is most noticeable when enough small branches have been removed to show the several basal stems. There is something solid or sturdy about the appearance of such a tree.

Columnar Trees

Columnar or narrow, upright-growing trees have as many landscape possibilities as do the "weepers." Let's look at evergreens first. A rocket-shaped Lawson-cypress form, *Chamaecyparis lawsoniana* 'Erecta,' with bright green foliage, retains a narrow head for what seems like eternity. Similar but lighter green is one of many narrow Chinese junipers, *Juniperus chinensis* 'Columnaris.' Also attractive, with a bluer cast: *J. c.* 'Mountbatten.' Swiss stone pine *(Pinus cembra),* generally—and unjustly—overlooked by plantsmen, is often close to being columnar.

Besides maples, of which a number of forms have been selected over the years for narrow growth, there are many choice columnar trees that lose their leaves in autumn. Among the best: Dawyck beech *(Fagus sylvatica* 'Dawyckii) and the similarly excellent *F. s.* 'Fastigiata'; also the columnar forms of English oak *(Quercus robur* 'Fastigiata'), smaller-growing Siberian crabapple *(Malus baccata* 'Columnaris'), Van Eseltine crabapple (*M.* x 'Van Eseltine') and Sargent Cherry (*Prunus sargentii* 'Columnaris').



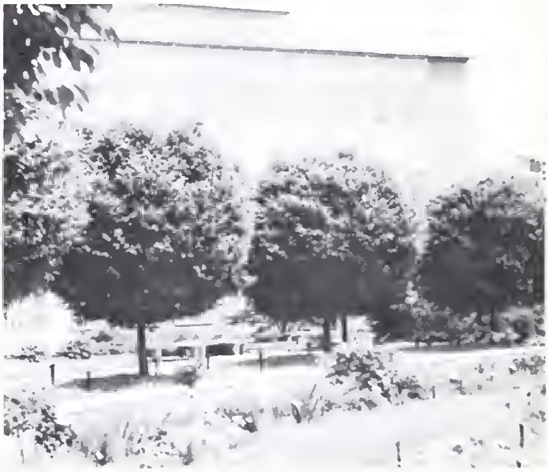
The shape of this columnar form of the Siberian crabapple *(Malus baccata* 'Columnaris') is distinctive. Other trees of columnar or fastigiate form exist.

Rounded or Globe Forms

The rounded outlines are truly globular in such grafted trees as globe Norway maple *(Acer platanoides* 'Globosum'), Almira Norway maple *(A. platanoides* 'Almira'), globe sugar maple *(A. saccharum* 'Globosum') and umbrella black locust *(Robinia pseudoacacia* 'Umbraculifera'). As they mature, hedge maple *(Acer campestre)* and white oak *(Quercus alba)* are just two among a number that form a more or less round head.

Some evergreens with rounded form are common box (*Buxus sempervirens*), globe red-cedar *(Juniperus virginiana* 'Globosa'), inkberry *(Ilex glabra)* and many low-growing selections of American arborvitae *(Thuja occidentalis),* such as 'Woodwardii,' and 'Globosa.'

—*Clarence E. Lewis*



Globe plant forms are illustrated by this row of globe forms of the smooth-leaved elm (*Ulmus carpinifolia* 'Umbraculifera').

"The designer should look to the natural landscape as a guide in the use of plant materials."

PLANTS AS DESIGN ELEMENTS

Dennis J. Day

PLANT materials can make a significant contribution in the improvement of our environment, both functionally as well as visually. The designer should look to the natural landscape as a guide in the use of plant materials.

The architect regards plants as design elements which are to be brought together with *other* design elements to create a unified scheme. Such a scheme should always be expressive of the character and function desired for the particular site. A key point is that plants should reinforce rather than merely ornament the overall picture. It is also important to look to the natural patterns of ecology as a guide in the selection and use of plants.

A plant, depending on its height, may usually be placed into one of three basic design categories: 1. *the overhead canopy;* 2. *the eye level focus;* 3. *the ground plane.* Each category should be carefully considered in the drawing of a landscape scheme or plan.

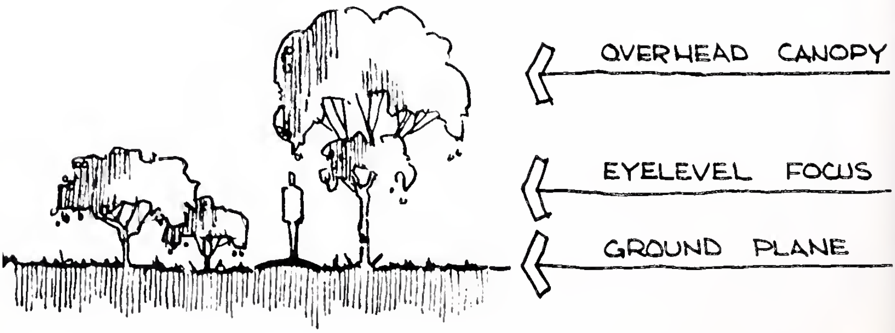
The overhead canopy generally gives the overall structure to a planting scheme. The plants in this category—actually trees of some size—tend to have high branches, which allow passage and observation under the canopy. At the same time, the canopy itself provides a sense of space definition and separation. Other functions of the canopy: to guide a person's path through a landscaped area (landscape architects call this the definition of circulation) and to encourage one to look in a particular direction; to provide shade; to link major features of the planting design.

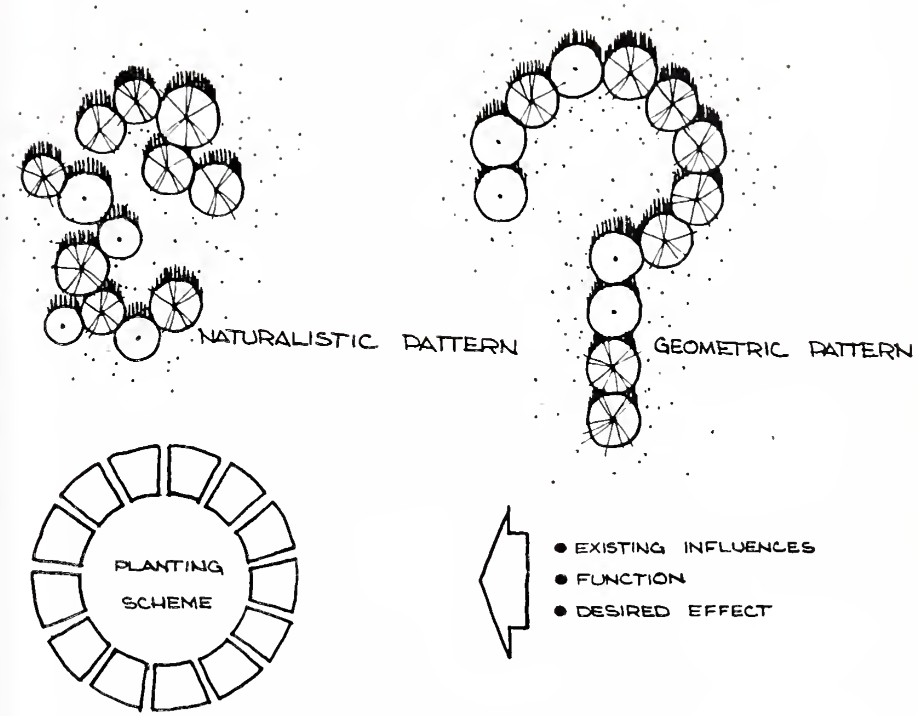
The eye level focus is the design category with the greatest immediate impact, because people—especially when walking—spend more time looking straight ahead than up or down. In this category, accordingly, the selection of plants—usually fair-sized shrubs or young trees—assumes special importance. Major functions of eye level plants: screening, enframement and accent. One good point to remember is that focus—in any direction—may be concentrated and reinforced by the choice of plants displaying conspicuous color, form or texture.

The ground plane serves as the base of a planting scheme. It is the major unifying element, the continuing carpet upon which all other elements are placed. Usually, the less interruption of that carpet, the more effective it becomes.

There are many kinds of ground cov-

All drawings by Dennis J. Day





PLANTING DESIGN CONSIDERATIONS

ers, evergreen and deciduous, from turf to low spreading shrubs and vines. Because they encompass a wide range of growth habits and heights, different ones may be put to work in different ways, whether it be to simply provide a surface for outdoor activities, to give definition to a path, or to stabilize soil from erosion. It is essential to plant durable, fast-recovering ones if people are going to walk on them! In sites which are to be walked upon only infrequently, there is greater freedom in the selection of a ground cover for visual effect.

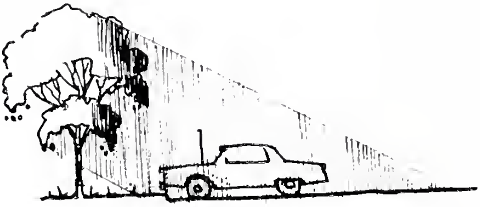
As a rule, planting schemes can be divided into two general patterns—naturalistic and geometric. It is unwise to fix upon one or the other pattern and apply it rigidly to all planting situations. Rather, it is much better to evaluate each situation separately, deciding which pattern might best complement the intent of the design. *Both* patterns may be appropriate in the same scheme, provided a transition between the two is made. Don't force a preconceived approach. The planting scheme should evolve as a blend of 1. *the natural influences* already existing; 2. *the function* it is to perform; 3. *the design effect* that is desired.

Plants are customarily more effective when grouped in masses than arranged singly, because, as a unit, they provide relatively greater emphasis and definition of space. The principle of massing applies to geometric as well as to naturalistic patterns. However, when plants are arranged as a series of single elements—that is, in an evenly spaced pattern with considerable distance between each one, the designer must be constantly on guard against creating a monotonous scheme.

Plants used as single elements have their place as specimens, of course. A specimen, in this sense, might be defined as a focal point to be highlighted much the same as a piece of sculpture might become the focal point of a plaza. Overuse of specimens, however, may distract from the scheme by decentralizing emphasis.

Plants can serve effectively as identification symbols by the repeated use of specific kinds in specific situations, such as at entry points to a building, walk, or in special-use areas. Even though the mental connection is usually subconscious, the sense of order and unity of such associations bring about and reinforce the intent of the design. Obviously, it helps if the plants chosen for this purpose have qualities that set them distinctly apart from others.

Plants as living things undergo continual change from season to season. The reds, oranges and yellows of autumn col-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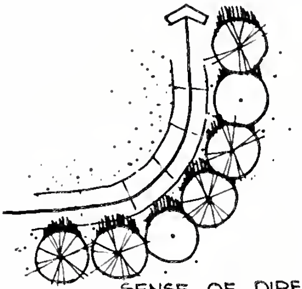
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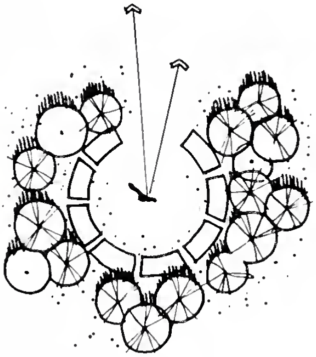
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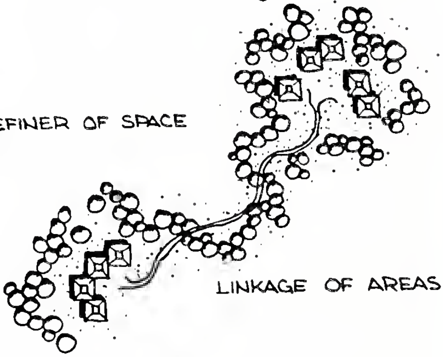
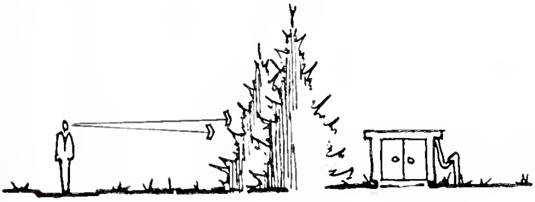

LINKAGE OF AREAS

POSSIBLE ENTRY ASSOCIATION
- ● LOW EVERGREEN SPREADERS
- ● CONSPICUOUS EYELEVEL ORNAMENTAL

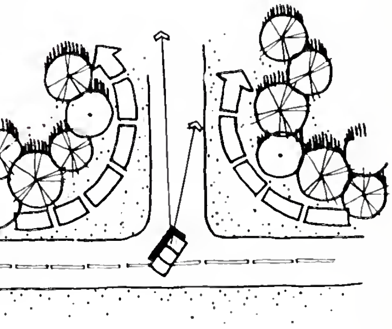
PLANTS AS IDENTIFICATION SYMBOLS

or; the pinks, whites, yellows and reds of spring bloom; the picturesque branching of a tree bare of leaves in winter; variations in bark coloration and texture; the summer foliage pattern. These are but a few of the seasonal contributions plants offer in terms of variety.

Remember, too, that plants change as the years go by. They not only grow larger, but many will also undergo a transition in branching habit or form as maturity approaches. Thought must be given to the appearance and function of the planting scheme some years hence, as well as at the time of installation. Few, if any, materials offer more opportunity to provide an ever changing, dynamic environment than do the many plant forms. It is up to us to emphasize this ever-changing quality by using them to their best advantage in carrying out our design. ◆



VISUAL SCREEN



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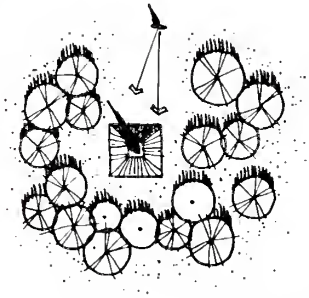
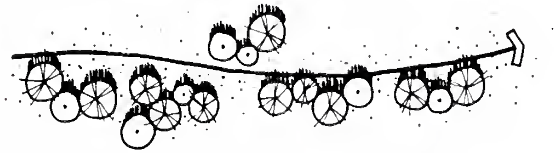
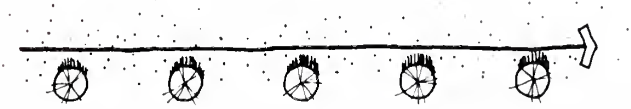


ENFRAMEMENT



PLANT MASSING MOST EFFECTIVE



PLANTS AS SINGLE ELEMENTS LEAST EFFECTIVE

"Conifers can give structure and color that will strengthen the outdoor space . . ."

USING CONIFEROUS EVERGREENS IN THE LANDSCAPE

Thomas W. Kehler

NEEDLE-LEAVED evergreen or coniferous trees are the natural elements in the landscape that provide containment, screening, enframement and background. They, in fact, often become the dominant spatial feature in a garden.

In the winter landscape, when deciduous trees have shed their leaves, conifers can give structure and color to the planting composition that will strengthen the outdoor space, whether the design of that space is symmetrical or asymmetrical. Carefully chosen, they, as well as broad-leaved evergreen trees and shrubs, may provide a background to emphasize the color, texture and form of foreground elements. Conifers are also unequaled as natural screens because the great majority of them retain their needles all year.

Landscape uses vary according to the natural shape or form of the tree. First, let's take a look at how conifers, apart from the shrubby ones, grow. They may be roughly divided into three forms: pyramidal, columnar and irregular. If weeping trees are separated from the last category, which seems sensible in view of their uncommon value as specimen plants in the landscape, we have a fourth.

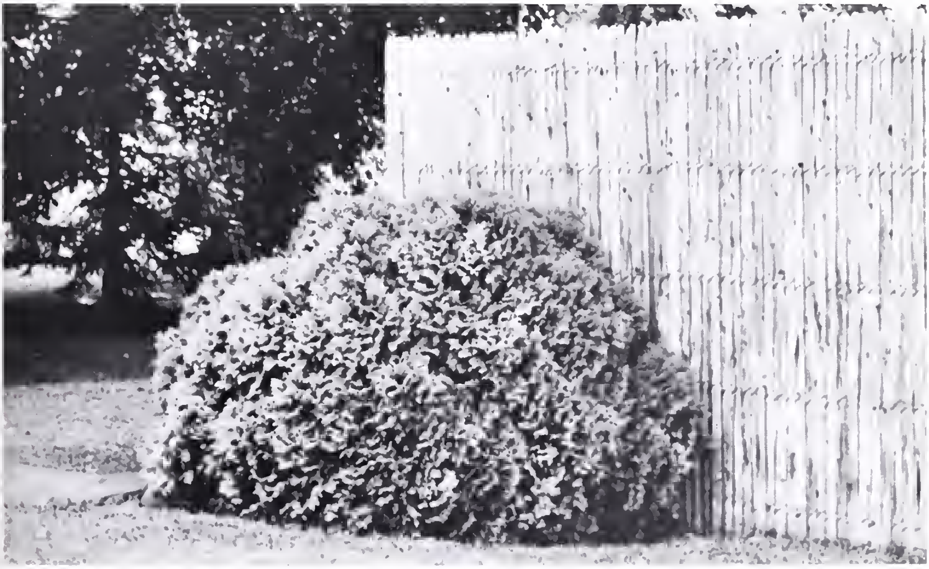
Fir, spruce, yew, hemlock and several of the pines are typically pyramidal, except in some of their cultivated varieties. Juniper (*Juniperus*), arborvitae (*Thuja*), and false-cypress (*Chamaecyparis*) are generally columnar, again with the same exception. The irregular habit of growth is most often encountered in the pines, particularly as they age. Weeping forms can be found in almost all the species of conifers, but spruce and hemlock variants are the hardiest and most commonly used.

M. M. Graff

The dwarf form of the Japanese juniper (*Juniperus procumbens* 'Nana') is a creeping, carpeting evergreen eminently suited to growing in rock crevices of walls and steps.

Clarence Lewis

The bristlecone pine (*Pinus aristata*) is a slow-growing evergreen of irregular shape.



Marjorie J. Dietz

One evergreen, such as this globe-shaped arborvitae, can be an impressive accent.

Pyramidal Conifers

Directly related to form is landscape use. Example: Consider for a moment how trees with an open irregular form might screen an objectionable view. Not very well. Yet, when a group of pyramidal evergreens is used in such a planting, they—and, in fact, only they—will totally obstruct the view. Because of the low branching habit, often to the ground, the pyramidal evergreen is the most useful of the various forms, except for the irregular form, which will be discussed later.

One special point to take into account with the pyramidal conifer is that the rigid form and deep color will create a bold accent in a planting dominated by deciduous trees. In addition, when the architecture of a building is a vertical shaft, like a campanile or bell tower, pyramidal evergreens can become a reflection of the vertical architectural pattern. Often this relationship is valuable as a means of relating buildings to landscape.

As a border planting to define space, the contrasting bold form and deep color of pyramidal conifers provide definite boundaries. Where a background is desirable to show off flowering trees or to give emphasis to interesting bark, the pyramidal form serves equally well.

Clarence E. Lewis

Dwarf white pine (*Pinus strobus* 'Nana') growing at Planting Fields on Long Island.

CHOICE CONIFERS BY OUTLINE OR FORM

Pyramidal

Abies nordmanniana (Nordmann Fir)
Juniperus chinensis 'Keteleeri' (Keteleer Juniper)
Juniperus virginiana 'Canaertii' (Canaert Red-cedar)
Picea abies (Norway Spruce)
Picea omorika (Serbian Spruce)
Picea orientalis (Oriental Spruce)
Pinus nigra var. nigra (Austrian Pine)
Taxus x *media* 'Adams' (Adams Hybrid Yew)
Thuja occidentalis 'Wareana' (Ware Arborvitae)
Tsuga canadensis (Canadian Hemlock)

Columnar

Chamaecyparis lawsoniana 'Allumii' (Scarab False-cypress)
Cupressus sempervirens 'Stricta' (Columnar Italian Cypress) (only for mild climates)
Juniperus chinensis 'Columnaris' (Columnar Chinese Juniper)
Juniperus chinensis 'Mas'
Juniperus chinensis 'Mountbatten'
Pinus cembra (Swiss Stone Pine)
Pinus strobus 'Fastigiata' (Columnar White Pine)
Pinus sylvestris 'Fastigiata' (Columnar Scots Pine)
Taxus baccata 'Fastigiata'; synonym, 'Stricta' (Irish Yew)
Thuja occidentalis 'Douglasii Pyramidalis' (Douglas Arborvitae)

Irregular

Abies homolepis (Nikko Fir)
Pinus aristata (Bristlecone Pine)
Pinus banksiana (Jack Pine)
Pinus flexilis (Limber Pine)
Pinus nigra var. nigra (Austrian Pine)
Pinus parviflora (Japanese White Pine)
Pinus rigida (Pitch Pine)
Pinus strobus (White Pine)
Pinus sylvestris (Scots Pine)
Pinus thunbergii (Japanese Black Pine)

Weeping

Cedrus deodara (Deodar Cedar)
Chamaecyparis lawsoniana 'Pendula' (Weeping Lawson False-cypress)
Chamaecyparis nootkatensis 'Pendula' (Weeping nootka False-cypress)
Juniperus virginiana 'Pendula' (Weeping Red-cedar)
Picea abies 'Pendula' (Weeping Norway Spruce)
Picea breweriana (Brewer or Siskiyou Spruce)
Picea pungens 'Glauca Pendula'; synonym, 'Pendens' (Weeping Colorado Blue Spruce)
Pinus strobus 'Pendula' (Weeping White Pine)
Pseudotsuga menziesii 'Pendula' (Weeping Douglas-fir)
Tsuga canadensis 'Pendula' (Sargent Hemlock)

(Continued)

Columnar Conifers

Columnar conifers are the most difficult forms to use in the landscape. The vertical and narrow habit does not mass into groupings, nor does it relate well to other forms. However, the narrow form has many uses on small and medium-sized properties. Probably the best employment is as a screen in the form of a hedge. One of several kinds of columnar trees that, properly sited, can be a very effective specimen in Japanese umbrella-pine (*Sciadopitys verticillata*), noted for its distinctive arrangement of whorled needles.

Conifers of Irregular Form

The picturesque, often horizontally branched conifers with irregular form are without question the most useful ones. This form does well as a specimen or accent at a building entrance or in the naturalistic landscape. Large and monotonous building facades can be divided into smaller, more interesting compositions by the lacy branching habit of this form.

If planted in staggered rows to make a loose screen or serve as a background planting for flowering trees, irregular forms are very successful. During the winter months the sculpture of a mature Scots pine (*Pinus sylvestris*) or Japanese red pine (*P. densiflora*) will dominate the snow-covered landscape. With proper spot lighting, the illuminated bark and branching structure will become an element of artistry in the night. An irregular form planted near a walk will create interest from a distance; when in the foreground, the branches which are allowed to hang over the walk will enframe the view beyond.

The Weeping Evergreen

The fourth form, the weeping evergreen tree, is not generally considered as a classification. But this unusual kind has real merit, especially as a specimen, and therefore should be on the landscape architect's tree palette. The large mound of deep green foliage of Sargent weeping hemlock is magnificent evidence.

The landscape architect, unlike the horticulturist who is usually concerned with the more immediate aspects of plant growth, considers plants as materials to employ for the purpose of creating compositions in space for human use. Form is the most important element to consider when selecting the correct species.

The list on page 17 which is based upon tree forms may be an aid in selecting the most appropriate evergreen tree for the specified use.

PLACING EVERGREEN TREES

EVERGREEN TREES should be used where they are congruous with the existing material and with the surrounding plantings. Never plant an even number of trees unless it is six or more. Where possible, develop unity in mass. Only in unusual circumstances will tree conifers in repetitive groupings accomplish the intended use. Don't choose them for foundation planting unless the building is large—and then it is best to plant irregular forms in groups or as part of a shrub composition. The other forms are generally too rigid and will compete with rather than complement the structure. Exception: where a pyramidal form will act in contrast to the structure and thereby give emphasis to the building form.

In the prairie landscape be especially cautious in locating columnar forms. Place them on side slopes with a background of rolling topography or deciduous trees. Avoid placement at the top of a hill. One generally good rule: follow Nature's example and your conifer planting will be successful.

—*Thomas W. Kehler*

"Vegetation overhead can frequently make a pleasing change from open sky."

TREES AND VINES CAN BECOME NATURAL CEILINGS

John D. Warbach

TREES and vines can be of special value when planted to form overhead planes—living roofs or natural ceilings. Arbors and vine-covered pergolas are common examples. Tree branches provide much the same experience if one is able to move underneath. Vegetation overhead can frequently make a pleasing change from open skies. Isolated in the landscape, a pergola may be an inviting place to go—a center of interest visually and functionally. The overhead latticework of a pergola, following a straight or curved walk or drive, emphasizes the direction of traffic or circulation. Also, not only can a paving pattern be mirrored in the module of cross pieces above, but the shadow of those cross pieces and the vegetation growing on them will create a pattern on the ground.

If you want to construct an overhead plane, think about the following:

1. Select plants according to their best traits for the design—and put them to work properly.
2. Some plants will need support to grow in the desired direction.
3. Some self-supporting plants can be made to form natural ceilings.

Regardless of how plants are made to grow overhead, remember such variable characteristics as form, color, texture and fragrance. Exploit each of them to best advantage and put their best combinations to work to create the desired effect.

Color is one of the most important factors. Leaf color, or the lack of distinction to it, will be noticed the entire

All drawings by John D. Warbach

Tree or shrub branches overhanging a walkway form a pleasant living ceiling.

season. New foliage will be one color—light green is common but other tints occur. Midseason leaves will be a different shade, while autumn brings a new range of hues. Since some plants used overhead have showy flowers, it is vital to choose ones with the right colors. Don't forget fruit color, either.

One less obvious point to bear in mind—whatever is built under the plant canopy will have its color affected by the light filtering through the leaves above. This light is often bluish-green unless the leaves are predominantly another color.

Consider texture, too, when choosing overhead plants. Different effects can be achieved by using fine, medium or coarse textures—or combinations thereof—with architectural materials. Beside leaf quality, think about flower texture. It becomes especially noticeable with plants that are heavily covered with hanging flowers. The fabric of branches and twigs should be taken into account, too, since in many parts of Canada and the United States plants may be without leaves for half the year. Whether it is summer or winter, the sun shining through the plants will cast shadow patterns on the walking surface, and it is wise to anticipate them.

Since parts of overhead plants are frequently close to the heads of passersby, make sure to at least avoid ones with an unpleasant odor—and try to select ones that have a fragrant quality. When fragrance is mentioned, flowers may come to mind first but the foliage alone of some trees and vines has delightful scents. Needle evergreens are especially fragrant. Even when there is no specific scent, leaves may add a certain fresh smell that cannot readily be described, but which can always be a subtle pleasure in the garden.

There are two basic methods by which plants are made to grow overhead. Vines and other trailing plants can be grown on pergolas or arbors. The other way is to make self-supporting plants grow to form natural ceilings.

Supports can be designed to remain visible or to be completely covered by the plants. Wood is the cheapest, and it blends well with plants because of its natural quality. Stone is sometimes used to develop solid supports for overhead cross members and as a natural route for vines aiming for the top. Wood and stone or wood and brick can be combined.

Self-supporting plants can be trained into natural arches inviting to walk under.

Sturdy supports are necessary for such vines as wisteria—desirable "natural ceiling" plants because of their airy foliage and fragrant flowers on drooping racemes.

Compromises may have to be made in design or selection of materials because of the different ways in which vines or trailing plants try to climb up the supports. Twining vines may need the extra help of horizontal members attached to the main supports, like the rungs of a ladder. Another possibility is to set the plant overhead and let the vegetation grown down. Drooping plants such as hanging-basket begonias and cascading petunias and geraniums may be grown in pots and the pots placed on the supports of a pergola to grow along the cross pieces.

If a structure would be out of place in the landscape plan or impractical to build, try using self-supporting plants which can form overhead planes. One way to do this is to take advantage of the habit of some plants to grow out over the walk, driveway or street. Widely vase-shaped trees placed opposite each other—with branches touching—form a canopy for people to walk or drive under. Horizontally branched trees also provide good canopies. Foliage density and branch height of trees differ greatly; the taller the tree the more layers of vegetation over the driveway or walk. As a tree grows older, it may lose its lower inner leaves, leaving only large branches close over the paving. Fortunately, there are some adaptable trees—pines and spruces provide a number of examples—that have horizontal branches, fragrance, and green foliage year-round. If particularly interesting trees are growing near a proposed walkway, it can be raised or lowered to allow people to pass under the branches close enough to enjoy them.

One final note on a time-honored art: Pleaching trees to develop arbors has been done in America since Colonial days. By this method, long tunnel-like arbors have been grown out of beech, yew and various flowering trees by tying double rows together to form a long inverted horseshoe. Extraneous branches are then trimmed away.

Included here is a brief list which I hope may spark further experimentation with plants for overhead planes.

Climbing plants: roses and grapes; wisteria; smilax; climbing hydrangea; English ivy (*Hedera helix*); and trumpet vine (*Campsis radicans*). **Trees:** ginkgo; pine; spruce; fir; larch; pear; cherry; beech; willow; magnolia; yew; holly; maple; oak. ◆

In addition to form, there is a tree's light value, "its ability under normal lighting situations to present a light, medium or dark shade of green . . ."

TREE FORMS AND THEIR LIGHT VALUES

Frederick Gerlach

THE FORM—shape or silhouette—of a tree is directly related to its growing or branching habit and also, to some extent, the effect on it from wind and light. By selecting appropriate forms, the designer of course may use trees to control vision—as in the screening of an objectionable view. However, he may also put trees to work in more subtle ways, perhaps to give a feeling of space or even a mood.

For such purposes, the imaginative designer considers a variety of factors, besides form. One of the most important has to do with a tree's "light value,"—its ability under normal lighting situations to present a light, medium or dark shade of green in the landscape. If greater emphasis is desirable in a planting, a tree's light value should contrast with values nearby. For less emphasis, the values might be similar.

According to their placement, trees of various forms may serve the designer in a number of ways. Columnar and pyramidal trees usually call attention to themselves because their silhouettes provide contrast with the rather horizontal quality of the landscape. They might serve to focus attention on some point in the landscape or to magnify the effect of a building where vertical lines are strong. Another use: to bring special emphasis to a hill or other rise in the terrain.

Weeping trees convey a passive, serene mood and are best planted where relaxation or contemplation is desired. Oval trees help blend vertical and horizontal masses. Picturesque trees, which usually have irregular branching, draw attention to themselves through individual character and are ideally used as accents. Vase-shaped ones, whose branching habit creates a feeling of space under their canopies, have an active, dynamic quality.

Consider a woody plant's height and mass before deciding how to use it in the landscape. A very young tree or shrub below eye level (5 feet) won't strongly define space or a view, but it can act as a psychological barrier to control the path that a person may be tempted to take in walking through a garden. Trees or shrubs whose heights are above eye level define space in greater degrees as they grow taller.

To be effective, the mass of a plant—its total size, including breadth—should be similar to the landscape situation or objects it is near. For example, a small tree is lost when placed alone next to a very sizable building. In this instance, many small trees or perhaps one large one may be needed for good effect.

The brief list that follows is a consideration of trees based upon their form or growth habit. It also gives their relative light values as discussed above. With the exception of *Cupressus sempervirens* 'Stricta,' the well known columnar Italian cypress of mild-climate gardens, and *Cedrus deodara*, the deodar cedar, these trees are hardy in most parts of the North. (See Brooklyn Botanic Garden Handbook 1200 TREES AND SHRUBS—WHERE TO BUY THEM for hardiness zones, common names, descriptions and nursery sources.)

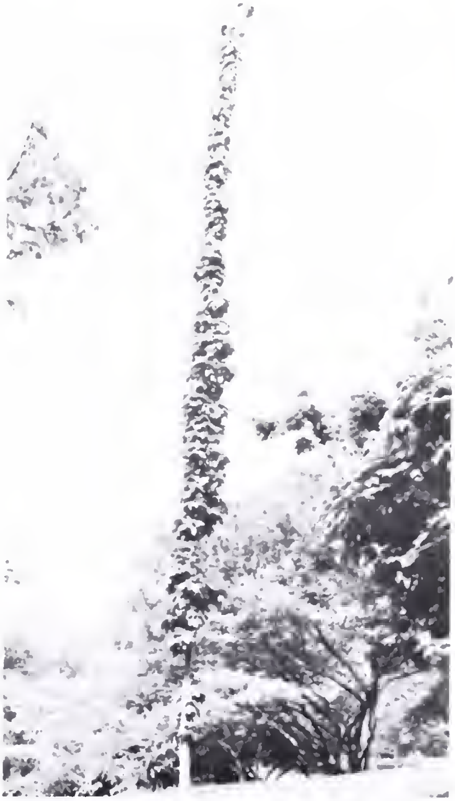
(*Continued*)

Marjorie J. Dietz

Above: A dark-leaved globe-shaped maple effectively complements the entrance of this dwelling.

Right: The unique, highly distinctive silhouette of 'Newton Sentry', a form of *Acer saccharum*, the sugar maple. It is considered of medium light value in the landscape.

Frederick McGourty, Jr.



PLANT GROUPS AND THEIR VALUES FROM LIGHT TO DARK

LIGHT VALUE	MEDIUM VALUE	DARK VALUE
Columnar (usually with ascending branching habit and height ratio of 8 units of height to one unit of width)		
Betula pendula 'Fastigiata'	Acer rubrum 'Columnare'	Acer platanoides 'Erectum'
Populus alba 'Pyramidalis'	Acer saccharum 'Newton Sentry'	Cupressus sempervirens 'Stricta'
		Fagus sylvatica 'Fastigiata'
Pyramidal (usually with horizontal to drooping lower branches)		
Abies concolor	Cedrus libani	Abies homolepis
Cedrus deodara	Picea omorika	Abies nordmanniana
Metasequoia glyptostroboides	Picea pungens	Picea abies
Pendulous (weeping branches)		
Betula pendula 'Gracilis'	Morus alba 'Pendula'	Fagus sylvatica 'Pendula'
Betula pendula 'Youngii'	Prunus subhirtella 'Pendula'	
Broad Oval to Spreading		
Cladrastis lutea	Acer campestre	Acer platanoides
Platanus occidentalis	Celtis occidentalis	Acer pseudoplatanus
Populus alba	Phellodendron amurense	Pinus nigra var. nigra
Salix alba	Quercus alba	Pinus thunbergii
	Quercus robur	
Right to Upright Oval		
Acer saccharinum	Fagus grandifolia	Quercus rubra
Ginkgo biloba	Gymnocladus dioicus	Quercus velutina
Tilia tomentosa	Tilia cordata	Tilia americana
Picturesque and Irregular		
Betula papyrifera	Carya ovata	Ilex aquifolium
Ginkgo biloba	Gymnocladus dioicus	Pinus nigra var. nigra
Gleditsia triacanthos	Malus hupehensis	Robinia pseudoacacia
Vase Shape (cathedral canopy or upright eventually arching)		
Koelreuteria paniculata	Carpinus caroliniana	
Laburnum anagyroides	Prunus serrulata	

The weeping variety of *Prunus subhirtella*, the Higan cherry, in full bloom.

M. M. Graf

"Weeping forms are recognized for their sculptural qualities . . . and special effects they create."

WEEPING FORMS IN THE LANDSCAPE

John and Deborah Edsall

YEARS ago it was thought that trees of a weeping character were bizarre and to plant them at all was in poor taste. The most common use of weeping forms was as specimen plants—singularly on lawns of the large estates that were developed during the late 19th and early 20th centuries. Weeping beech (*Fagus sylvatica* 'Pendula') was a favorite in such situations.

Today, however, weeping forms are recognized for their sculptural qualities and appreciated for the special effects they can create. Such effects may be achieved by the use of just one plant or several. There are over sixty cultivated varieties of weeping trees existing now. This number includes both deciduous and evergreen kinds, but the majority are deciduous. Most can be grown in the moderate and cool climate zones (Zones 2-7, Arnold Arboretum map). Few are found in the Lower South.

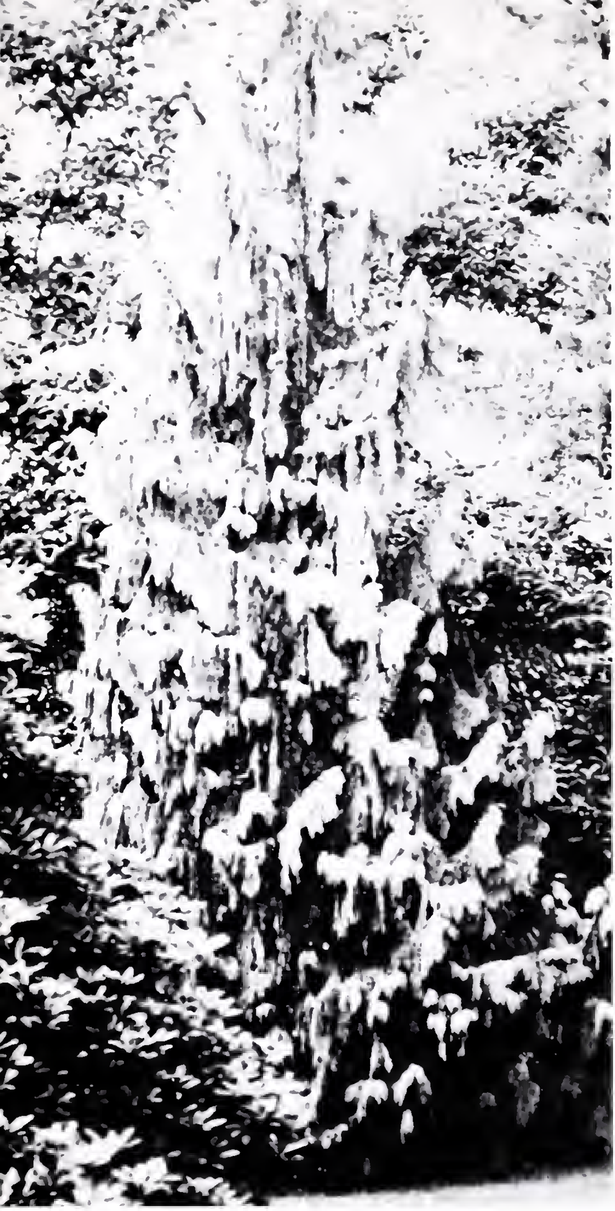
Probably the best known tree with pendulous branches is weeping willow (*Salix babylonica* [but *S. alba* 'Tristis,' *S. blanda* and others with similar growth habit are also familiar]. In fact, the planting of the weeping willow at a pond edge or a grave has become such a cliché that it has probably led to the decline of its use. According to Mrs. Schuyler Van Rensselaer in her book *Art Out-of-Doors*: "The very worst place for a weeping willow, worse than in the center of a lawn, is the very place where we most often find it—beside a placid sheet of water. The beauty of a little sheet of water is the beauty of repose, of simplicity, of breadth, of horizontal lines; with all these qualities the drooping lines of the weeping willow conflict." Weeping willows, if used in conjunction with water at all, look best overhanging a cascade where the falling moving lines of water harmonize with those of the willow. "Interesting design effects can be obtained by lining walks or roadways with the Babylon willow creating a dark tunnel of green, lengthening the apparent distance." (Robert L. Zion, *Trees for Architecture and the Landscape*. Reinhold Book Company, New York. 1968. p. 195.)

If willows are planted on a mound at different levels, the "billowiness" of the foliage outline is intensified, as exemplified at Constitution Plaza, Hartford, Connecticut.

The overall goal of planting design is to create a picture of harmony. Lines should grow out of lines, or one plant outline out of another. It is necessary for the designer to preserve harmony in the landscape, minimizing discord of nature's forms. Often, plants with weeping forms are introduced into the landscape to produce a sudden contrast of form, an accent. However, sudden changes in plant forms should be used sparingly since too many accents can become incongruous and discordant.

Also, ill-placed accents in the landscape are destructive to the balance and pattern of the overall design. While plants with contrasting forms do not provide unity and harmony in design, they do prevent monotony and add interest. A change in plant form is most effective when color and/or texture of the surrounding plant materials do not vary. The strong character of weeping plants is occasionally introduced for special effect just like a bright color is introduced into a design for emphasis.

(Continued)



The 'Pendula' form of the Nootka false-cypress *(Chamaecyparis nootkatensis)*.

OUTSTANDING WEEPING TREES

Betula pendula 'Youngii' (Young's Weeping European Birch)
Fagus sylvatica 'Pendula' (Weeping European Beech)
Fagus sylvatica 'Purpureo-Pendula' (Purple Weeping Beech)
Malus 'Red Jade' (Red Jade Crabapple)
Morus alba 'Pendula' (Teas Mulberry)
Picea abies 'Pendula' (Weeping Norway Spruce)
Prunus subhirtella 'Pendula' (Weeping Higan Cherry)
Sophora japonica 'Pendula' (Weeping Scholar or Pagoda Tree)
Tilia petiolaris (Weeping Silver Linden)
Tsuga canadensis 'Pendula' (Sargent Hemlock)

Photographs by Clarence E. Lewis

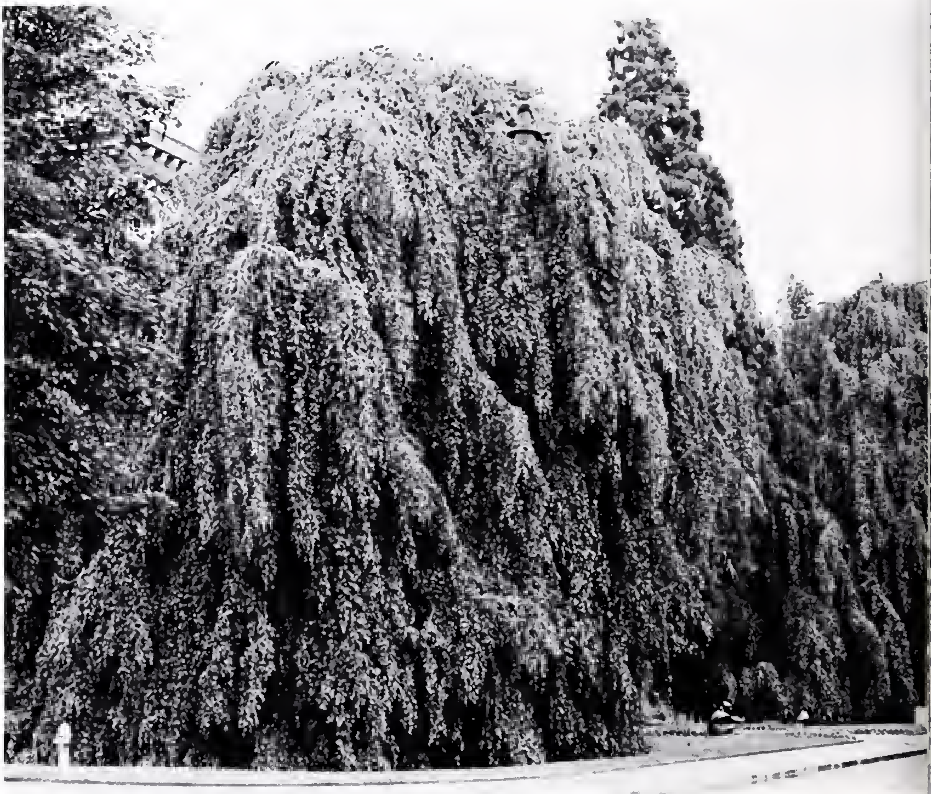
A rather young plant of the Sargent hemlock. Compare with aged plant on page 8.

The Sungari rockspray (*Cotoneaster racemiflora soongorica*) has a weeping habit. It has gray-green leaves, small white flowers in late spring and pink berries in fall.

(*Continued from page* 25)

Plants with a weeping form can be used to create a mood through the visual outline they possess and through their branching habit. Symbolically, weeping forms have characterized beauty, gracefulness, the picturesque, femininity, softness, sorrow and elegance. Many times plants with weeping forms are introduced to break up the formality of a design. Plants which are unusual, however, should be used with extreme caution for they can often introduce extraneous effects. The pendulous branching habit of weeping trees automatically leads the eye downward. Hence weeping trees are frequently well placed with other kinds of plants to "edge down" a planting mass.

While these forms can be situated advantageously by themselves, a weeping tree is usually seen to best advantage when it stands against a group or mass of contrasting foliage. The softer lines act as an accent in front of the stiffer, more upright forms. When weeping trees are mixed with other round-headed trees they lose character. The effect of the pendulous outline is also lost when concealed by adjoining trees. Therefore, weeping plant forms are best used: by themselves either singularly or in a row or grouping; against a backdrop of a planting mass or building wall; and on the edge of a border planting. In all three cases the weeping form is used only where special emphasis is needed or desired. ◆



R. Schoeni

This magnificent and ancient specimen of the weeping European beech grows in Zofingen, Switzerland.

"The answers to a landscape problem may come most readily by observing the natural scene."

The spruces of the boreal forest seem cold, monotonous, uninspired forms of trees.

OBSERVATIONS ON TREE FORM AND THE WESTERN LANDSCAPE

R. Hugh Knowles

IN the man-made landscape, the designer has two principal criteria in the selection of tree forms. Most clearly, the form chosen for a particular site should be functionally acceptable—suited to the use to which it will be put. Second, and more subtly, it must provide a visual or emotional impact that will help the total landscaped space achieve "image quality." It usually isn't difficult to choose plants that will satisfy the first specification, but the second requirement is often ignored or poorly conceived.

Image quality is often not attained, I think, partly because of the tendency of many designers—and people generally—to rely on certain arbitrarily conceived rules concerning the choice and use of tree forms in the landscape, without taking into account some important qualifying factor. As a landscape architect and plantsman, I must confess that my reaction to strict rules about the use and placement of trees is a cool one. I feel that each planting situation must be judged on the basis of its own peculiarities, and that the answers to a landscape problem may come most readily by observing the natural scene.

Recently, in the West, I have had an opportunity to reflect on the form of the spruce tree, not from the customary point of view of design, but from how the tree grows in nature and its emotional impact under different landscape situations. I have always thought of spruce as a rugged, vigorous tree, capable of dominating most things, but after observing it closely in the wild, I am inclined to regard it as a tree which, depending on

The favorable effects of a landscape on the viewer are heightened by good weather.

All photographs by R. Hugh Knowles

The columnar shapes of the Lombardy poplar contrast sharply with this horizontal base plane. The reflections of the trees in the lake add to the contrast.

the environment, can also express sheer unbridled monotony.

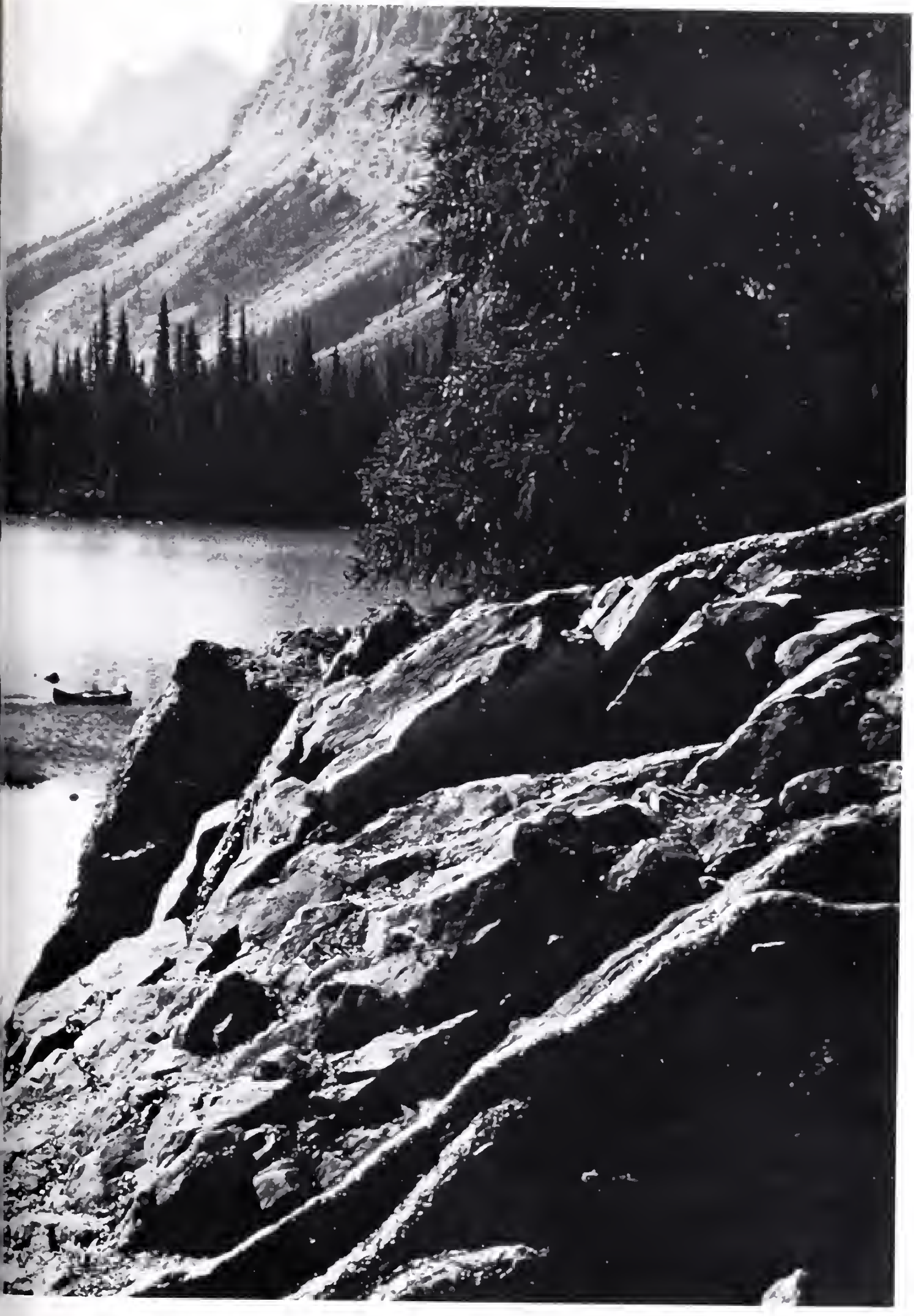
Because of similarly rigorous environments, spruce has become the dominant tree form in two natural plant landscapes—the subalpine and the boreal. Since each of these landscapes has a unique face or physiography, the spruce trees express themselves in different ways. In parts of the mountainous (alpine, subalpine) regions of the West, where there is a background of immense scale dominated by snowy peaks, Engelmann spruce (*Picea engelmannii*) is indeed a rugged, vigorous tree. In its thrust skywards it reflects everything one associates with the wild, beautiful mountains, and the impact of the tree is greater because of the ever-changing landscape.

In a boreal setting, however, where vast even-aged stands of another species, black spruce (*P. mariana*), hug the shoreline of every loon-inhabited northern lake, the illusion is not simply one of tranquility. Rather, because of the cold emptiness of the boreal forest and the flat unbroken skyline, it is also one of repetition and loneliness. In architectural terms this landscape is an enclosed type with no variety expressed in the walls of the enclosure or on the surface of the base plane.

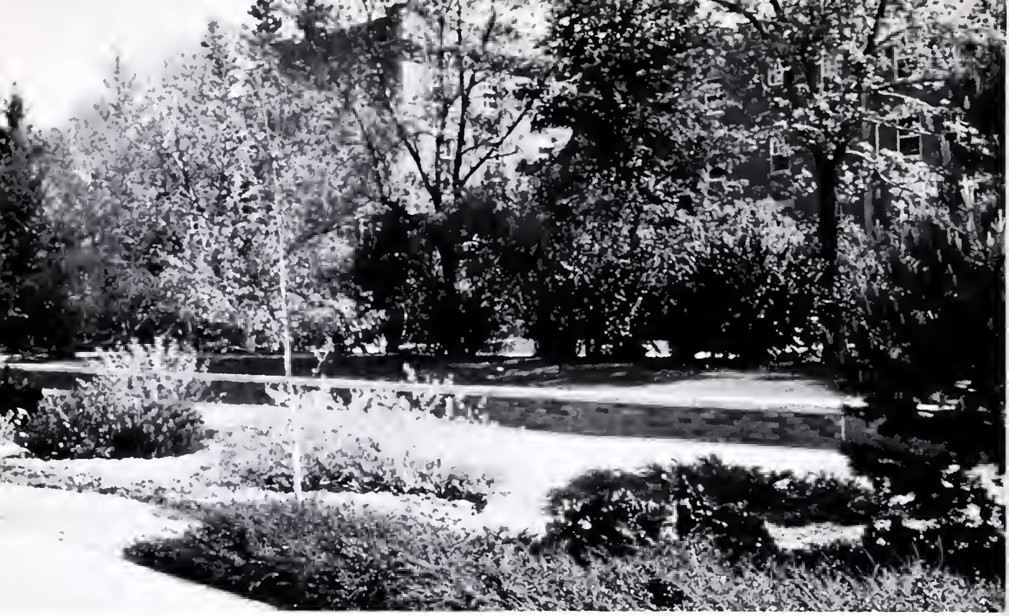
A person's response to the tree form may also be affected by the transitory influences of light and time of year. Nowhere is the effect of light on trees better illustrated than in the western plains. In eastern landscapes, diurnal variations in light intensity are much less extreme, so the average observer, except possibly the photographer, is not usually conscious of any best time for viewing. The Westerner, on the other hand, knows that from four o'clock until sundown the landscape will be washed with a soft warm light and, as a result, gain a striking dimension that cannot be perceived in midday.

One of the typical western landscapes

(Continued)



The spruce trees of the mountains are plant forms of tremendous strength, vigor and inspiration, as this magnificent panorama of a natural Western landscape shows.



Landscapes vary in their dramatic impact according to the amount of light they receive in a 24-hour day or in the season of the year.

is the aspen parkland, a rolling pastoral setting in which pictures are constantly changing on the "big screen." It is a kind of landscape that relies totally on combinations and *changing* combinations of what might be called *receivers* and *transmitters* that can capture and send the mood of a moment, the time of day, and the day of the year.

Spruce, aspen, birch and willow, which—along with topography and ground cover—are the receivers and transmitters of the parkland, may not be a distinguished group of woody plants when form is considered, but they are most effective under certain light conditions. When the intensity of the sun is at its greatest, all are receiving and transmitting at their peak. Even the dark green of spruce is strident in this light. However, as the intensity decreases, the transmitting qualities of the trees lessen in different ways. Spruce and willow become receivers only, while birch and aspen maintain a high degree of light transmission. Such variations in response to reduced light intensity do marvellous things for the aspen parkland, as I am sure they would for any landscape in which consideration had been given to the absorptive and reflective properties of tree foliage.

In late September and early October, the transmission qualities of this western landscape rise to new heights. Also, at this time of year, the interaction of the trees with the edge of the base plane is very small. However, between the various groups of trees, the play of light that is often accentuated by the changeable early autumn sky makes a visit to this landscape a memorable experience.

When autumn color wanes in the aspen parkland, a new receiver-transmitter becomes apparent. This is the golden stubble of the grain fields. It is the dominant element in a landscape where trees, with the approach of winter, are receiving little and transmitting even less.

Fortunately for the aspen parkland, the receivers and transmitters of autumn and winter are not the only elements of the base plane. Shrubby willows and dwarf birches, inhabiting the wet places that man and his beasts avoid, spring to life with the dropping of the leaves and, until spring returns, they transmit a rich red glow which under all light intensities gives interest to a scene that otherwise would have been dull and lifeless. ◆

"Underground stems push through the soil, coming up in ever-widening circles from the parent plant."

PLANTS THAT WALK!

Joseph T. Cox

TREES and shrubs are generally thought to be stationary. Their main stem or trunk doesn't move laterally in the soil, but some plants put a "best foot forward" to increase the species. This could be called "walking." The plantsman or landscape novice should know about this trait of some plants, especially before he allows the existing vegetation to be stripped from a future home site. If "walking trees and shrubs" will compete with new plantings, it is true that this would be the best time to get rid of them, but the thoughtful designer may find it desirable to retain some in the landscape scheme.

Typical walking plants are sassafras, sumac, lilac, bittersweet, also many kinds of willow. These "drifters" frequently show different characteristics—among them, creeping, mounding and stepladder growth.

The most perceptive homeowners have turned away from the old habit of having pointed evergreens at every corner of the house, with low flat ones circling between them like beads on a string. Much greater interest is now shown in the copse type of planting, where several trees or shrubs of the same kind are planted in a loose group. Copse plantings may be given a new magnitude by the use of trees and shrubs that grow sidewise as they attain greater height.

Walking plants are often indicators of sandy or poor soils. Further, they may indicate porous soils where drainage is good. They suggest soil characteristics that are good for home sites but too poor in moisture retention for the satisfactory growth of most crops except berries, vines, fruit and forest trees.

An unusual effect may be gained by conserving the sassafras (*Sassafras albidum*) on a rolling sandy ridge. The tree is a shapely pyramid in winter, and in spring

All photographs from Michigan State University Information Service

Certain "drifting" plants—such as this willow—show special characteristics. Other native plants which possess a walking tendency include clethra, benzoin, many deciduous azaleas, and most of the shrubby forms of dogwood such as *Cornus alba*.

The lilac is an example of a commonly cultivated ornamental with a walking tendency —or if you prefer, a habit of suckering, especially when abandoned by gardeners.

and summer it has other merits, especially the varied foliage. There are four differently shaped leaves on the tree—left-lobed, right-lobed, double-lobed and entire (that is, with uninterrupted margin). This is a trait shared by few other plants.

Other well known plants may be added to the list of those which walk. Knowledge of their spreading habit will suggest where and how they may best be used. Japanese pachysandra (*Pachysandra terminalis*) is one of the most obedient and satisfactory ground covers, as well as one of the most widely encountered. Because it spreads by underground stems, it ought to be planted where a foundation wall, metal edge or paved walk will keep it properly confined. Pachysandra prefers partial to full shade.

Sumacs (*Rhus*) are well known for their walking habit. Some people consider them pests because of their suckers, but it must be admitted that the brilliant red autumn color is matched by few other shrubs. Also, the sumac leaflet has a predominantly fine texture.

The walking habit of sumac is much the same as with sassafras. Underground stems push through the soil, coming up in ever-widening circles from the parent plant. If allowed to grow freely it will result in a copse-like formation.

The silhouette of an undisturbed mature clump of sumac is a flattened half-sphere. The oldest stems, in the middle, are the tallest, while extending from the center there are successively younger ones, until at the periphery, the stems are but one or two years old. Over ten to twenty years it would be possible to plot the movement of this walking shrub or shrub-like tree.

Common lilac (*Syringa vulgaris*) is another shrub with a walking tendency or, if you prefer, a history of suckers. Many people associate lilacs with abandoned farmhouses and old-time dooryards where, left undisturbed, they form handsome large mounds over the years. Yet, the drifting habit of this shrub is regarded with distaste by some gardeners.

There are many other trees, shrubs and ground covers that walk. You might want to draw up a list of your own. Recognition of them will be a help in either saving on-site plants or marking them for removal if they threaten to compete with new plantings. Some of the most dramatic landscape compositions on home grounds, in state and national parks, and in arboreta are large masses of trees, shrubs and herbaceous plants. Such effects are often accomplished by simply letting the existing plants roam—within reason. Mother Nature has a way of teaching, if we will be good observers. ◆

Above: Much more interest is now shown in duplicating or retaining "copse" plantings, such as this grove of sassafras trees.

Right: Worth protecting is this "walking" sassafras on a rolling, sandy ridge.

"We are surrounded in our contemporary environment with many areas, activities and objects which we would rather not see at all."

THE SCREENING ABILITY OF TREES AND SHRUBS

Gary O. Robinette

THE DEVELOPMENT of our environment causes disruption of the natural landscape. As more and more construction takes place—and on an ever larger scale—man's surroundings tend to become increasingly ugly. We are surrounded in our contemporary environment with many areas, activities and objects which we would rather not see at all. Screening is the visual blocking out of that which is unsightly with something that is more harmonious or at least less offensive. Screening is the means of providing visual control in the landscape through view direction and "negation" of ugliness by simply hiding it. Screening implies the isolation, confinment and concealment of the unwanted while allowing free human access and visibility to the remainder of the landscape.

There are various screening elements, including buildings, topography, walls and fences, but none is more widely employed than plants, nor less understood as to their potentialities and limitations. Plant screens have of course been used for many years, but they gained a particularly wide acceptance—and a certain notoriety—in hiding objectionable views during the highway beautification efforts of the 1960's. In this period, surprisingly few quantitative data were assembled on their screening ability, so now, as the world grows ever more crowded and cluttered, there is an increasing need for studies of the effectiveness of individual ones.

Plants may be used in much the same way as any other screening element. However, it must be kept in mind that they are growing, changing materials and are, therefore, somewhat less dependable

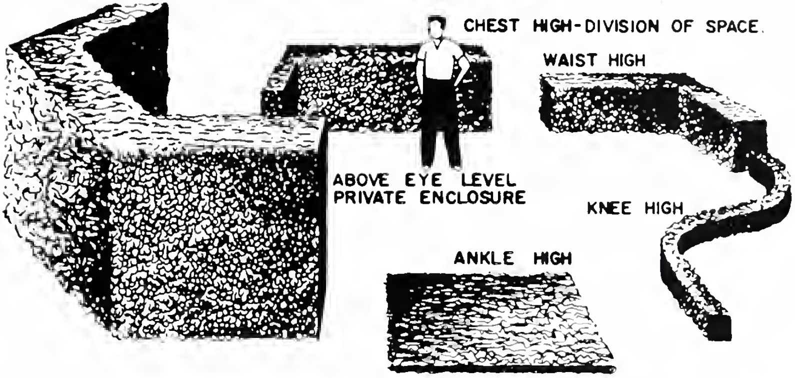
(*Continued*)

Gary Robinette

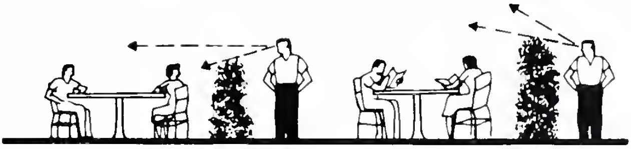
A single plant may be utilized to screen out unwanted views and to focus on the more desirable aspects of a view, as is shown by this planting in Oakland, California.

WALLS

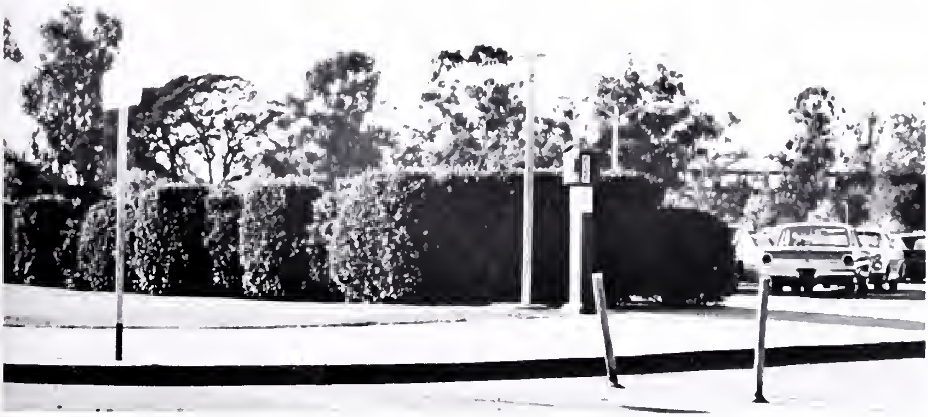
THE INDIVIDUAL'S RELATIONSHIP TO SHRUBS DETERMINES THE BEST HEIGHT FOR A PARTICULAR PLANTING. ANKLE HEIGHT TO COVER THE GROUND, KNEE-HIGH FOR DIRECTION, WAIST HIGH FOR TRAFFIC CONTROL AND PARTIAL ENCLOSURE.



PEOPLE

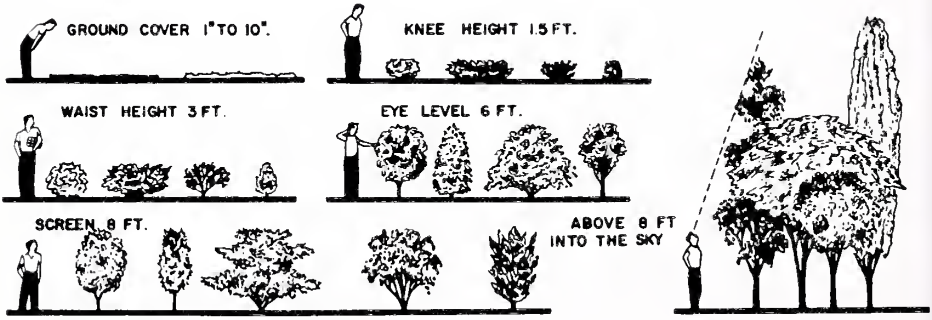


PEOPLE-THEIR LINE OF VISION DETERMINES WHETHER A FENCE WILL PROVIDE PRIVACY OR MERELY SEPARATION. THEIR HEIGHT MEASURES FENCES, SHRUBS, TREES, AND ALL VERTICAL AND OVERHEAD ELEMENTS.

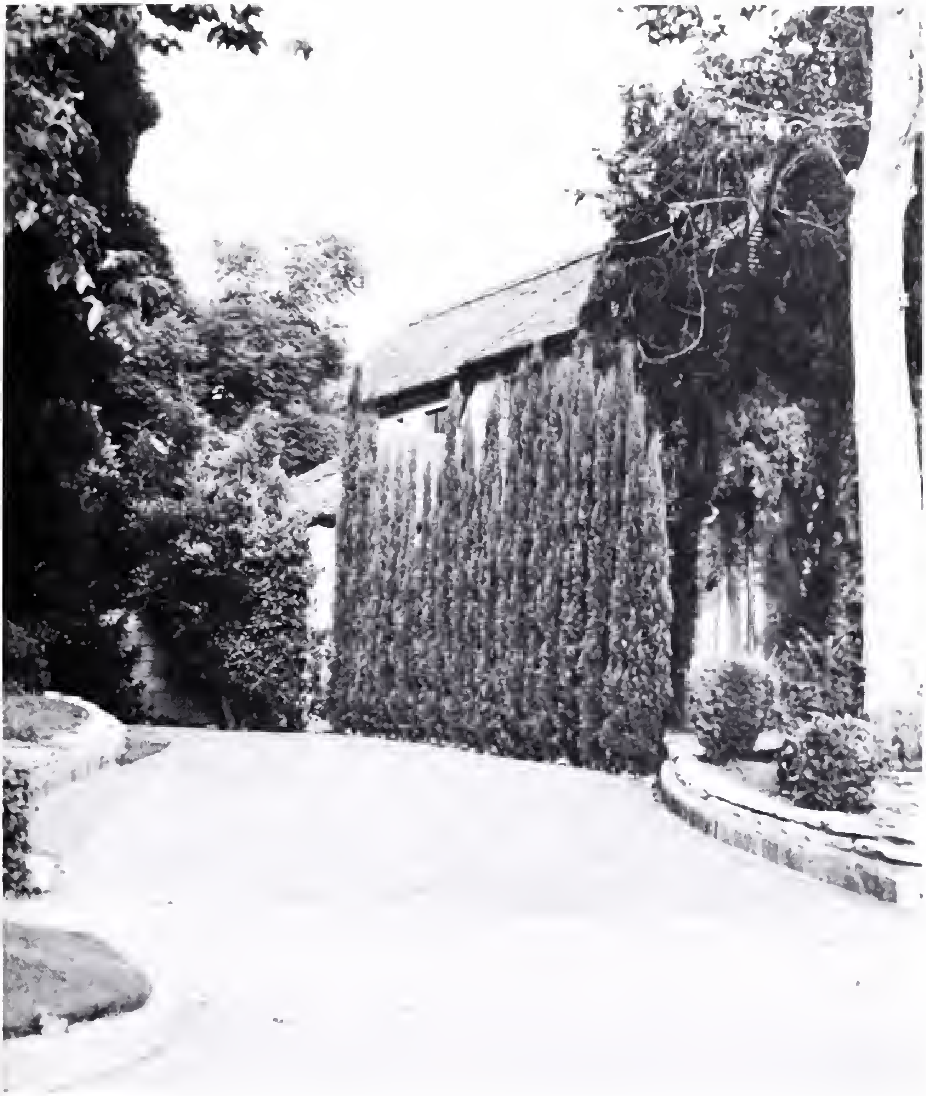


In Los Angeles, vast expanses of parked automobiles are screened by shrub plantings.

Tall pyramidal trees, such as these Bolleana poplars, provide higher screening than is usually possible from either shrubs or trees of canopy form.



SELECTING PLANT MATERIALS



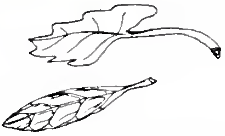
A row of Italian cypress trees screen the service area of a house in Beverly Hills.

and predictable in their density and ultimate form than fences, walls or buildings. They have, though, the unique benefit of their naturalness as well as their inherent design characteristics, such as form, color and texture. By carefully selecting and arranging them, it is possible to gracefully hide objectionable views and to guide the eye to more pleasing parts of the landscape.

A single plant has bulk and occupies space. Hence, it—or a group of plants—can restrict human sight to varying degrees. While a single plant may be an individual object, that same plant, when spaced closely in sequence, creates a wall. The degree to which a plant filters or blocks a view depends on the type of plant, its age and condition, its density, volume, height and width, the number of

A. DENSITY

1 PETIOLE SIZE, SHAPE AND LENGTH

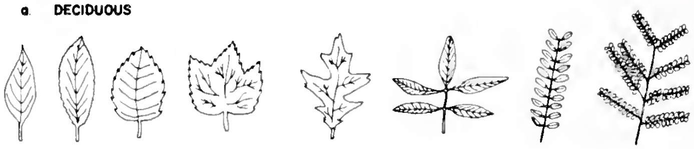


- ◇ SQUARE
- ○ CIRCULAR
- ⬭ OVAL
- △ TRIANGULAR
- ⯃ OCTANGULAR

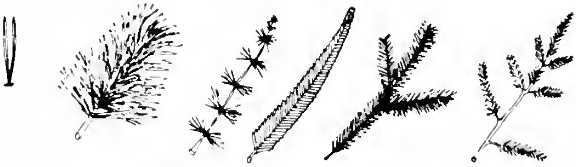
SOME PETIOLE SHAPES HAVE MORE STRUCTURAL STABILITY THAN DO OTHERS. ON PLANTS WITH STRONGER PETIOLES THERE IS LESS MOVEMENT AS THERE IS WITH SHORT PETIOLES, THUS THE PLANT APPEARS MORE SOLID AND DENSE.

2. ARRANGEMENT OF LEAVES

a. DECIDUOUS

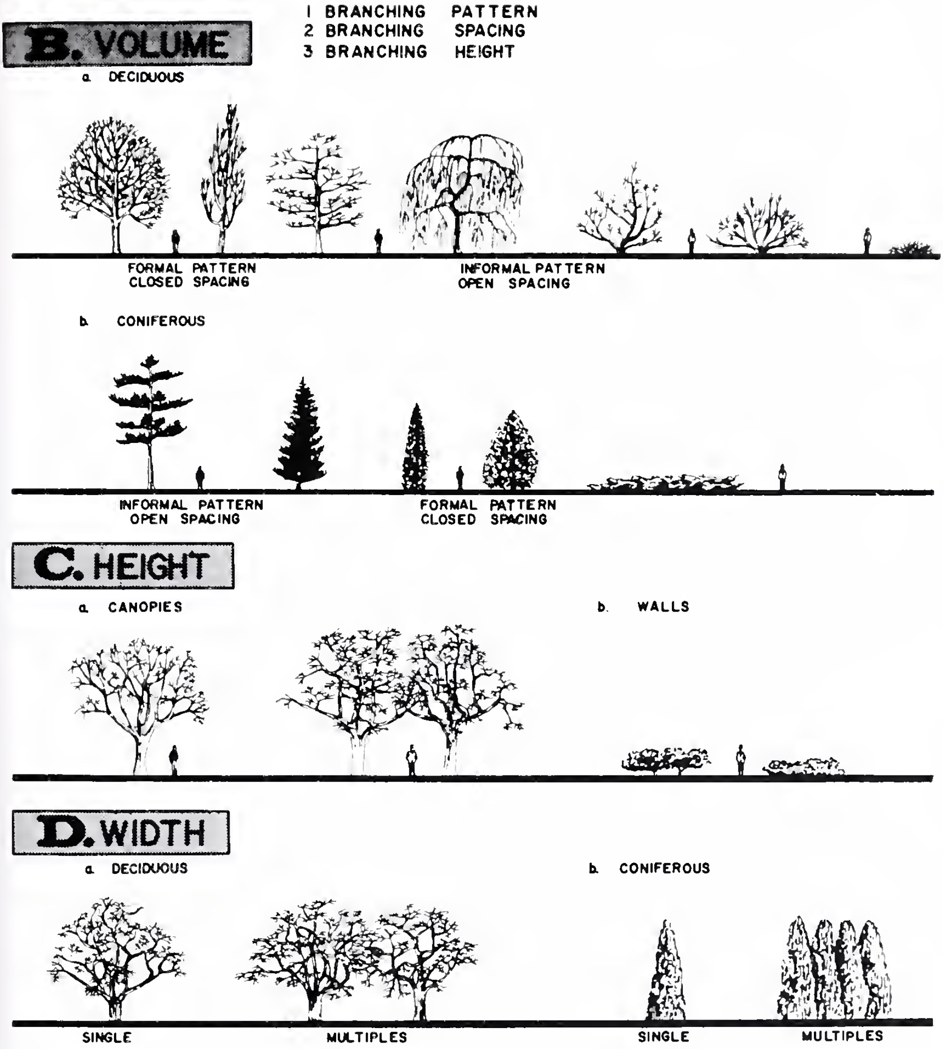


b. EVERGREEN



LEAVES ARE ARRANGED IN GENERAL ORDER OF INCREASING COMPLEXITY OF FORM AND/OR MARGIN FROM LEFT TO RIGHT. THIS INCREASING COMPLEXITY COMBINED WITH VARIOUS BRANCHING FORMS WILL PRODUCE VARYING DEGREES OF DENSITY.

ARCHITECTURAL USE OF PLANT MATERIAL

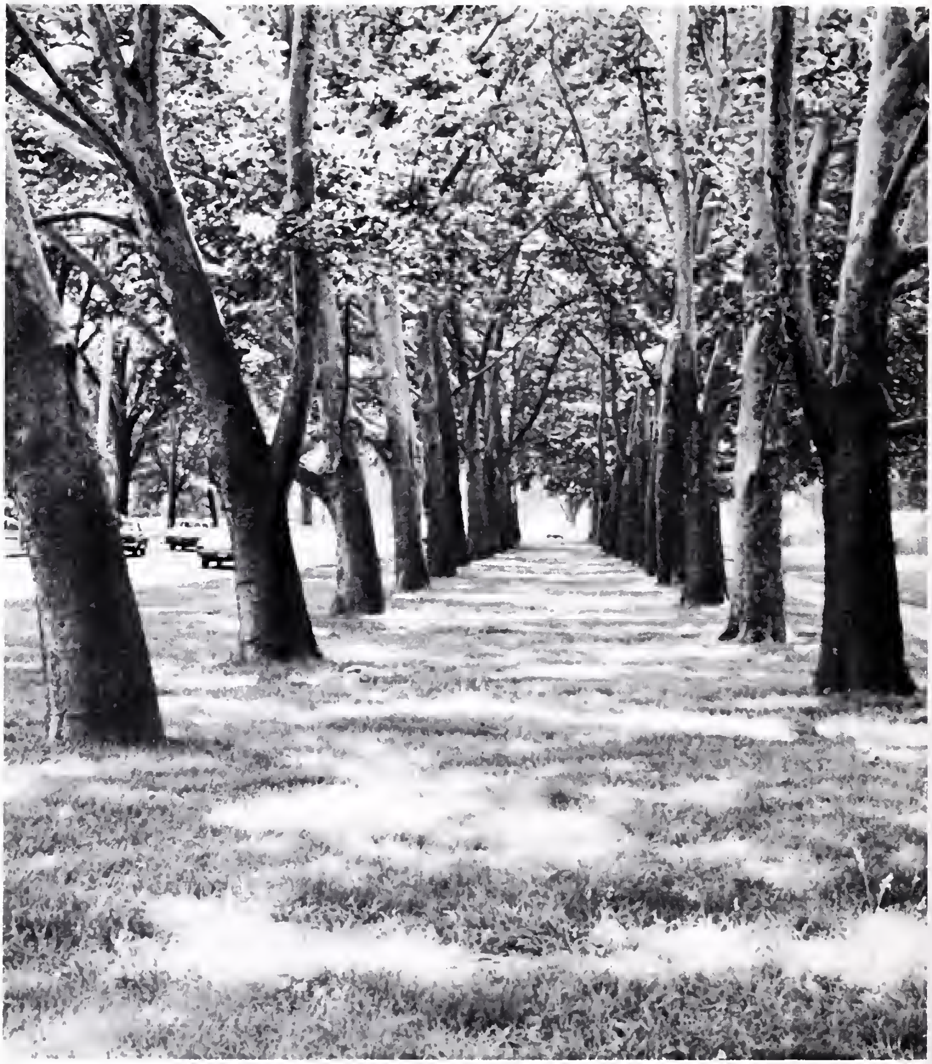


plants used, and spacing between plants.

Different kinds of plants, depending on their foliage density and branching habits, have different degrees of opacity, translucency or transparency. These degrees can also be affected by the closeness of plant spacing in a screen. Not all situations call for equally dense screens, and sometimes a veil may be more desirable than a complete hiding of a view. Occasionally, just a single tree with picturesque spreading branches may be successful in partly obscuring a view of a building or other architectural feature to make it more interesting.

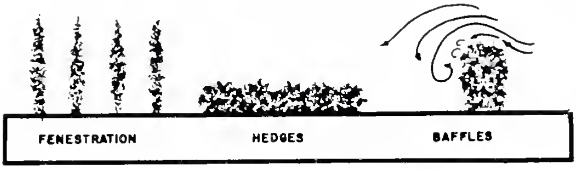
We usually think of screens as consisting of one kind of plant, or at least one type of silhouette or form. However, if we judiciously mix plants of different shapes, densities and heights, it is possible to create an infinite variety of view filtration. Not only should spacing be taken into consideration to add to the spectrum of possible densities, but even the season of year can be an important factor with many plants. Obviously, a screen of deciduous trees performs better in summer to block a view than in winter.

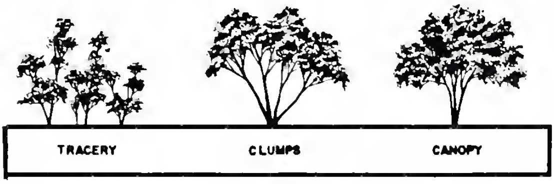
There are many kinds of plants used in screening. They vary in effectiveness according to the situation and geographical area, and it is wise to consult a landscape architect and nurseryman to find the best for one's own purposes. Regardless of choice, however, plants should be considered high on the list of screening elements, not only for their ability "to do the job" admirably, but also for the beauty which they bring to the environment through their form, color and texture. ◆

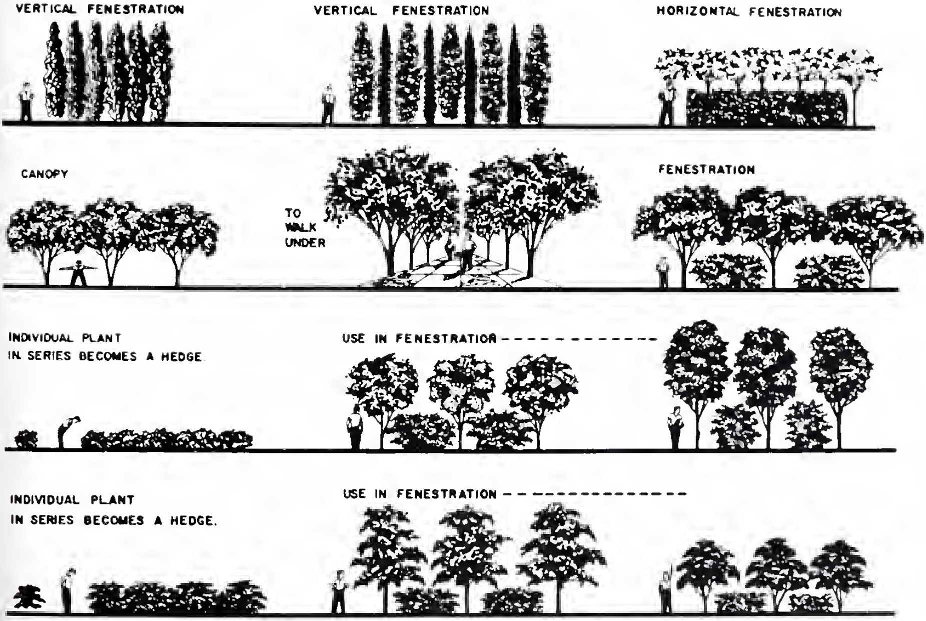


A planting of London-plane trees *(Platanus acerifolia)* provides a pleasant canopy and screening for both pedestrians and automobile traffic along a busy thoroughfare.

FUNCTIONAL USE
OF PLANT MATERIALS






VERTICAL FENESTRATION
VERTICAL FENESTRATION
HORIZONTAL FENESTRATION
CANOPY
TO WALK UNDER
FENESTRATION
INDIVIDUAL PLANT IN SERIES BECOMES A HEDGE
USE IN FENESTRATION ------------
INDIVIDUAL PLANT IN SERIES BECOMES A HEDGE.
USE IN FENESTRATION ---------------

"The climate of the tropics and other warm areas influences both plant life and human thought."

PICTURESQUE TREES IN THE SUBTROPIC LANDSCAPE

Michael E. Pirich

BESIDES having an obviously important effect on the plants common to such parts, the tropical climate helps set the frame of mind of people living or visiting there. For human transplants from the temperate zone, the vegetation of the tropics gives a strangely beautiful —one is tempted to say exotic—flavor to physical settings that are not always distinguishable from parts of the North. Of course, to a person who has always lived in warm climates, the distinctive plant material is taken for granted until a trip north provides an awakening. Because most tropical trees and shrubs have picturesque or irregular forms, it would be pointless to compile even a representative list. Here, then, are a few of my personal choices.

Palm trees and the tropics are synonymous to most people, with most palms, in fact, being exclusively tropical. The coconut (*Cocos nucifera*), apart from its great importance in many local economies, is a visual symbol of the tropics. It is the palm associated with shorelines—naturally so, since its fruits float and the giant seed enclosed in each one germinates easily on sandy beaches, creating in some places dense shady groves.

Florida landscape architects often select the coconut as the backbone of a planting when a tropical appearance is desired. The trees are usually planted in groups, with at least three to a group. Their slender graceful trunks, curved and leaning, look well this way and the luxuriant tuft of foliage at the top gives shade that a single coconut cannot. Coconuts grow to 80 feet or more, and their fronds, actually pinnate leaves, are up to 20 feet long.

Several other plants are eminently suited to give a "tropical" effect. Among them: Paurotis palm (*Acoelorrhaphe* or *Paurotis wrightii*), forming a multi-stemmed clump to 20-25 feet tall, with fan-shaped leaves; lady palm (*Rhapis excelsa*), clump-growing to 6 feet, with fan-shaped leaves, useful in shady spots or indoors. Having the general appearance of a palm (but not one), screw-pine (*Pandanus utilis*), a small tree under Florida conditions, looks as if it is growing on stilts because of its aerial rootlets, and has an odd, angular branching habit. Tufts of long, narrow-pointed leaves are concentrated at the ends of branches. Six-inch-wide, cone-shaped fruits, resembling pineapples, are an added attraction.

Others in this landscape category: Areca palm (*Chrysalidocarpus lutescens*), a multi-stemmed plant to 20 feet tall with feather-shaped leaves arching outwards from center, best used as a screen or background plant; thatch palm (*Thrinax parviflora*), to 25 feet with a straight slender trunk and a small head of fan-shaped leaves. Dracena (*Dracaena marginata*), which is not a palm but a member of the lily family, gives a tropical appearance with an oriental flavor. Its contorted stems support small heads of narrow pointed leaves that are 18 inches long. Dracena is usually seen as an accent plant on patios and along entranceways, but it is also adapted to indoor use.

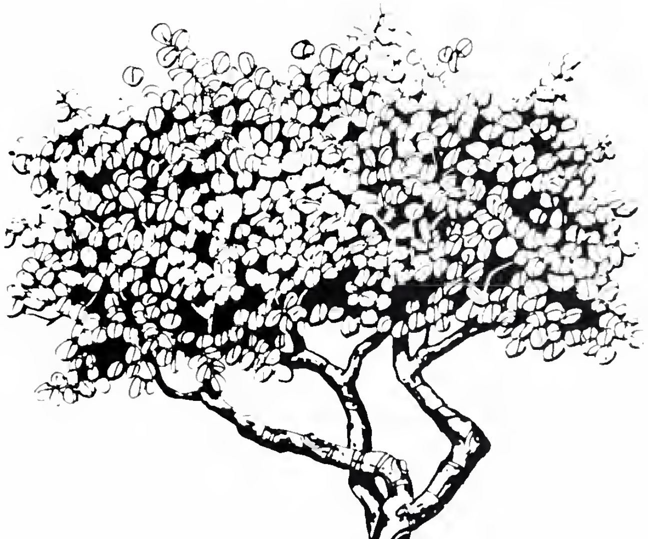
In any discussion of palms, two of the most stately should be mentioned—Mexican fan palm (*Washingtonia robusta*) and royal palm (*Roystonea regia*). Since both can grow to 100 feet and look their best in groups, they have

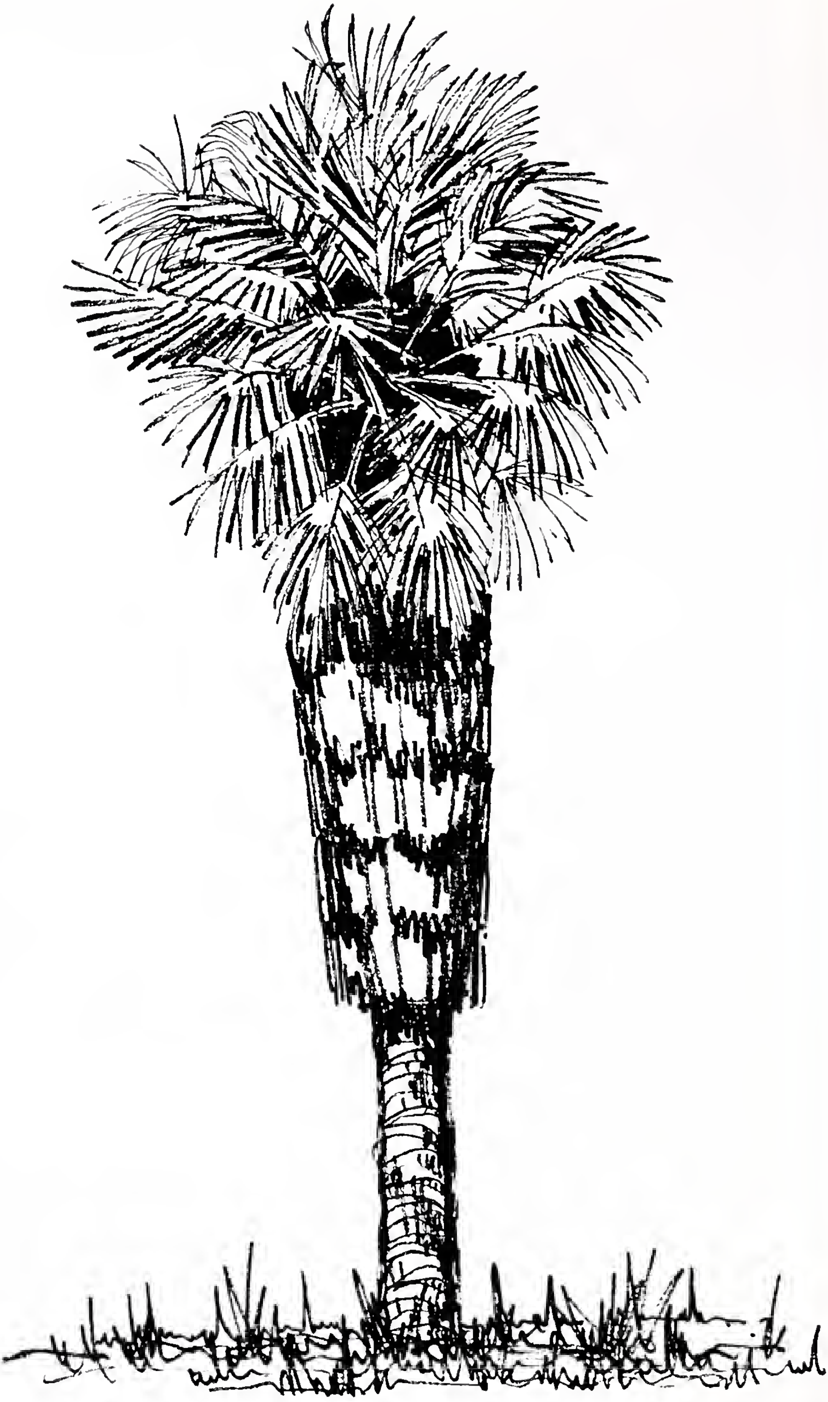
Three sabal palms *(Sabal palmetto)* tower above a sea-grape *(Coccoloba uvifera).*

Sabal or cabbage palm, a more hardy palm, grows from N. Carolina to Florida.

Drawings and photographs by Clarence E. Lewis

The sea-grape has a picturesque growth habit. Its grape-like fruits are sometimes made into jelly.





The Mexican fan palm *(Washingtonia robusta)* is a large, stately palm. Its landscape use should be restricted to roadside plantings or groupings in parks or estates.

An extensive planting of the royal palm, another palm suitable for grand scale use.

limited value in many planting situations. However, each has character that can enhance estates or parks. When used in mass, they create a vertical rhythm in the landscape.

Mexican fan palm is remarkable because its straight trunk may have as much as a 40-foot "skirt" of dead leaves attached to it. Instead of being unattractive, they add grace to the tree, and old plantings give an aura of romance.

The striking gray-white trunks and bulging bases of royal palms suggest Greek or Roman columns when a number of these trees are planted together. One of the best uses is in street beautification. Royal palms are also often grouped around the homes of winter residents, where, in time, they may create an estate atmosphere.

Several other palms might be noted here. Canary Island date palm (*Phoenix canariensis*), growing to 60 feet, has a massive, almost barrel-like trunk and a globose head of arching and drooping leaves at the top. The leaves are often 20 feet long, and the old leaf stalks persist. The tree is usually out of place on a small property and is best suited for streets, parks and estates. It may be used as an accent because of its distinctive appearance.

Cabbage palm (*Sabal palmetto*), to about 20 feet, has 4-5-foot wide, gray-green leaves at the top. They are pleated and fan-shaped. The bases of the old leaf stalks form a criss-cross pattern on the trunk, Uses: many, from avenue planting to massive groupings. Also of note—Queen palm (*Arecastrum romanzoffianum*), to 40 feet, with fine-textured, feathery leaves that arch from the top. It is a graceful tree adapted to residential use.

Shade trees in the warm-climate landscape are as important (in some cases more important) as in other regions. They temper the atmosphere created by constant hot sun—both physically and *psychologically*, besides performing the usual functions that shade trees do everywhere. As in cooler parts, their selection depends upon quality and form of canopy, density of shade, texture and color of

The India-laurel *(Ficus retusa* variety *nitida)* forms a dense, round-headed tree.

foliage and, of course, how they will complement the landscape design.

Southern live oak (*Quercus virginiana*) is one of the most picturesque shade trees in Florida and the Lower South. It has a low, broad crown often three times the height of the tree, and the spreading, coarse branches, frequently draped with Spanish moss, have a great deal of character. Unless an old specimen is already on the site, it takes a long time to achieve the best landscape effect. Although the growth rate of this long-lived tree is relatively fast, the massive size necessary for maximum effect takes many years. Main use: avenue and park plantings. In milder parts of California, coast live oak (*Q. agrifolia*), which has a similar form, might be substituted.

A variety of the Indian-laurel fig, ***Ficus retusa*** var. ***nitida*** (often called simply ***Ficus nitida***), provides very dense shade. Form: exceptionally dense, rounded crown, with short, stout trunk (up to 3 feet across). Height: to 80 feet. Leaves: small, dark green, closely set. Added character: numerous aerial rootlets. The tree is not a fig which is grown for its fruits.

Royal poinciana (*Delonix regia*), which may serve as a shade or street tree, although it is most frequently encountered as a specimen tree in the home landscape, is renowned for its beauty. It is probably the most spectacular flowering tree of the tropics. It is certainly one that many Florida residents and visitors rate as the most beautiful tree in the world.

An established royal poinciana has a broad, spreading crown and gnarled, buttressed trunk which are particularly conspicuous from January to April, when the tree is leafless. With the advent of the wet season in early May, the tree bursts into full bloom almost overnight, a trait not uncommon to flowering trees that originate in the tropics. The brilliant flowers, scarlet to yellow-orange depending on the tree, fully cover the crown. Soon after flowering begins, fine-textured, bipinnate leaves appear, providing a sharp contrast to the flowers. After the leaves fall, the 1-2-foot long seed pods add to the winter character.

(Continued)

Above: The royal poinciana *(Delonix regia)*, although a familiar sight in Florida, is not native there, but comes from Madagascar. *Right:* Gumbo-limbo *(Bursera simaruba)* has a rugged, picturesque frame. To be fully appreciated, it should be planted on vast lawns rather than small plots.

Dracena *(Dracaena marginalis)* is suitable in scale for home garden plantings.

The unique screw-pine *(Pandanus utilis)* is palm-like, but neither palm nor pine.

There are many other picturesque trees in the warm-climate landscape, but it is possible to mention in list form only a few of the most useful ones here:

Frangipani (*Plumeria* spp.). **Height**: 20 feet. **Form**: no uniform growth habit; seldom straight-trunked. **Flowers**: red, pink or white, fragrant and long-lasting (useful in decorations); they appear at the tips of the stiff, thick, fleshy branches and are especially prominent because they occur when the tree is leafless. **Use**: in gardens of almost any size, also in parks.

Gumbo limbo (*Bursera simaruba*). **Height**: to 60 feet. **Form**: irregular, with massive trunk often two feet wide; large, spreading branches stand out because the foliage is not dense. **Bark**: outstanding; smooth, shiny, reddish-brown, peeling. **Use**: large grounds, parks or avenues where the form can lend distinction.

Sea-Grape (*Coccoloba uvifera*). **Height**: occasionally to 30 feet. **Form**: variable —from low prostrate shrub to broad, spreading tree; many interesting shapes along the windswept coast (the plant is common to many tropical shores). **Leaves**: very large, rounded, coarse. **Bark**: flaking, with gray, brown and white splotches. **Use**: depends on the form; ground cover, hedge, espalier, etc. Excellent when planted with coconut palm at seaside.

Jacaranda (*Jacaranda acutifolia*). **Height**: to 50 feet. **Form**: asymmetrical, open. **Flowers**: blue-violet, bell-shaped, in large clusters, from April to June; appearing before the leaves. **Foliage**: wispy, bipinnate. **Use**: shade or specimen tree; commonly seen around residences. The pleasant profile contrasts well with coarse-textured plants in the background.

Jerusalem-thorn (*Parkinsonia aculeata*) **Height**: 30 feet. **Form**: open, spreading, erratic; trunk crooked, with yellow-green bark. **Flowers**: yellow, pea-like, showy from March to July **Foliage**: very fine texture; leaves have drooping appearance similar to a

The coconut palm (*Cocos nucifera*) has slender, gracefully curving trunks up to 80 feet or so. It is the palm associated with tropical shorelines.

weeping willow; deciduous. **Use:** specimen plant on patio or around homes. Best effect occurs when silhouetted against dark greens.

Finally, when a touch of the temperate in the tropical setting is desired, slash pine (*Pinus caribaea*) can best create it. This fast-growing tree has a high, irregular canopy that becomes more picturesque with age. The pine odor is present, of course, and the fine shade patterns are welcome for home landscapes. The tree is also useful for roadsides, estates and parks. ◆

Left: The slash pine *(Pinus caribaea)*, while hardly tropical in appearance, is a picturesque pine for warm climates. *Below:* The Canary Island date palm *(Phoenix canariensis)* has a massive trunk and head out of scale for most home properties.

"Texture . . . the subtle thread which runs through a well-conceived design."

TEXTURE AND THE LANDSCAPE

Albert F. Collins

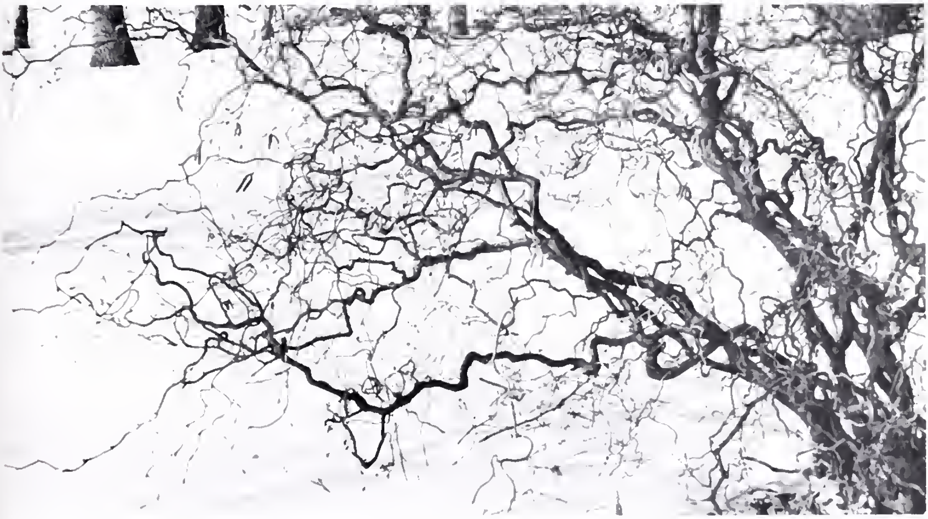
TEXTURE is one of the most important facets of a landscape. It is the subtle thread which runs through a well-conceived design. Texture is the elusive beauty painters try to capture on canvas and poets try to put into verse. The imaginative landscape architect, too, has the ability to draw this elusive imp from his palette and give the landscape a feeling of life.

A landscape architect turns the changing seasons to his advantage by being keenly aware of how they act on plants. The seasons bring on many textural and pattern changes. White ash (*Fraxinus americana*) has coarse twigs and leaflets of fair texture, each prominent at different times of the year. A similar yearly contrast occurs with Japanese maple (*Acer palmatum*), which may be admired in summer for the quality of its foliage as well as in winter for its refined twigs.

Sweet gum (*Liquidambar styraciflua*) presents an interesting seasonal change of texture when the leaves fall, revealing the unusual corky ridges of the twigs and the tree's special pyramidal form. The same is true of winged euonymous (*Euonymus alatus*), not to mention its brilliant autumn color, which suggests another common name—burning-bush. "Harry Lauder's walking stick" (*Corylus avellana* 'Contorta'), actually a shrubby kind of hazelnut, performs its quick-change act in the autumn when the rough and wrinkled leaves tumble, disclosing a twisted outline and a mixture of coarse and moderately contorted twigs.

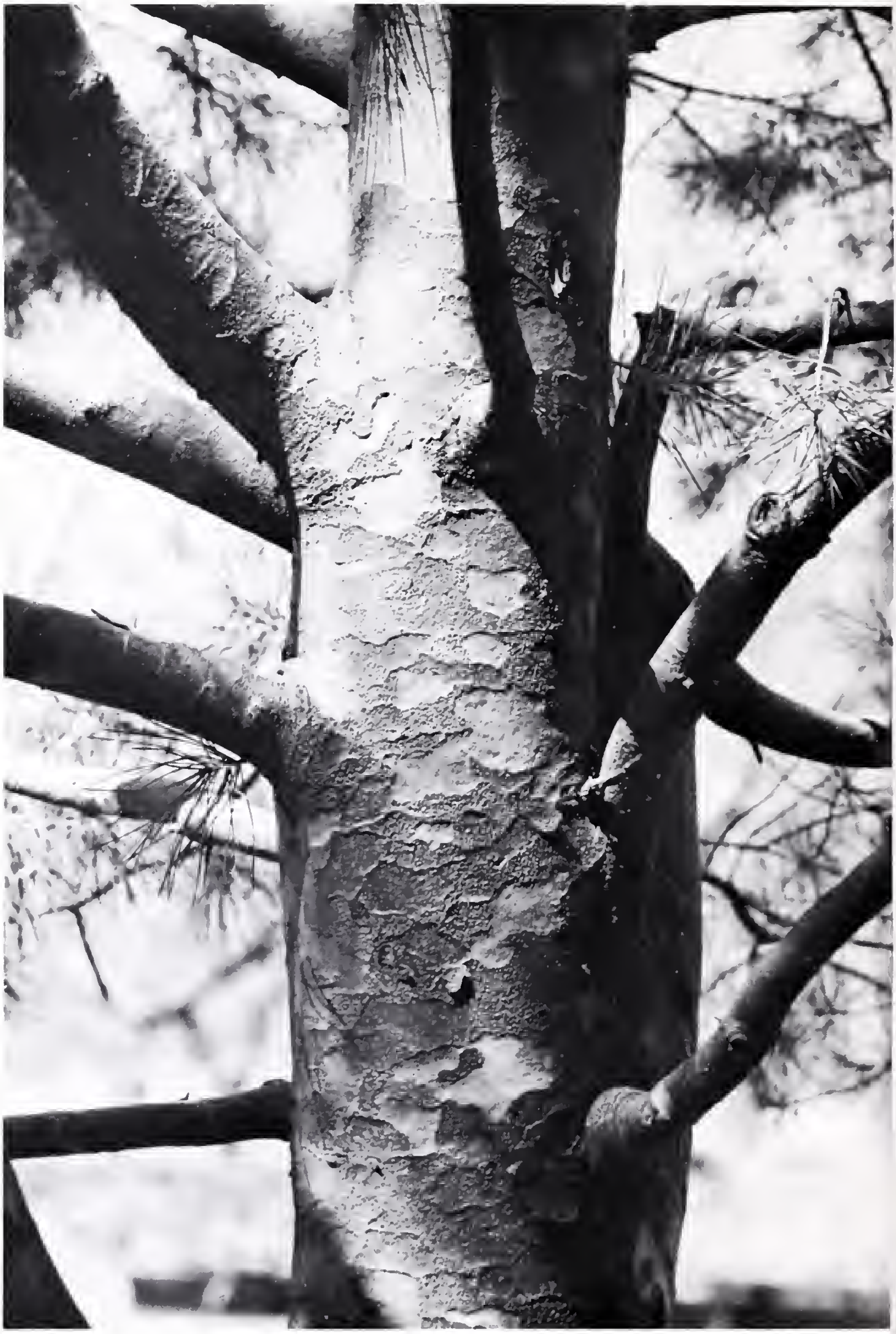
The list of textural changes continues through autumn, but after the leaves disappear, revealing the branch structure

(*Text continued on page 58*)



All photographs by M. M. Graff

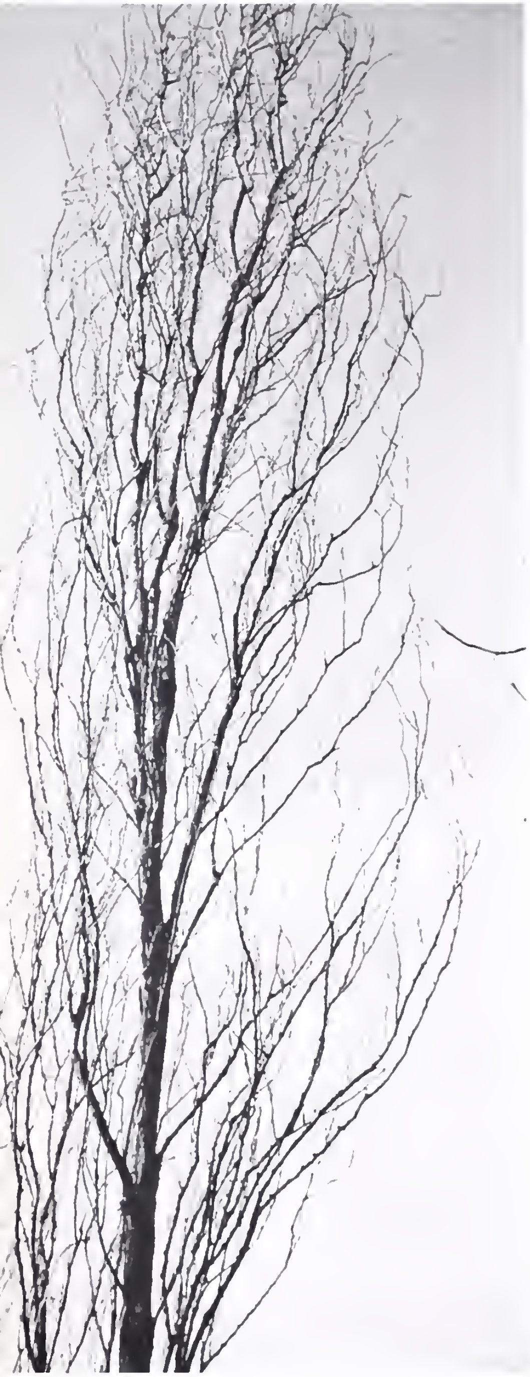
"Harry Lauder's walking stick"—one name for a form of the European hazelnut (*Corylus avellana* 'Contorta')— displays its complex branch patterns against snow.



The distinctive pattern of the lacebark pine (*Pinus bungeana*), caused by exfoliating bark, becomes more apparent as the tree matures.

It takes the winter season to reveal the twisted branch pattern of the corkscrew willow (*Salix matsudana* 'Tortuosa'). *Right:* the impressive frame of the London-plane in winter.

(Continued)



The black locust in fastigiate form—*Robinia pseudoacacia* 'Pyramidalis.'

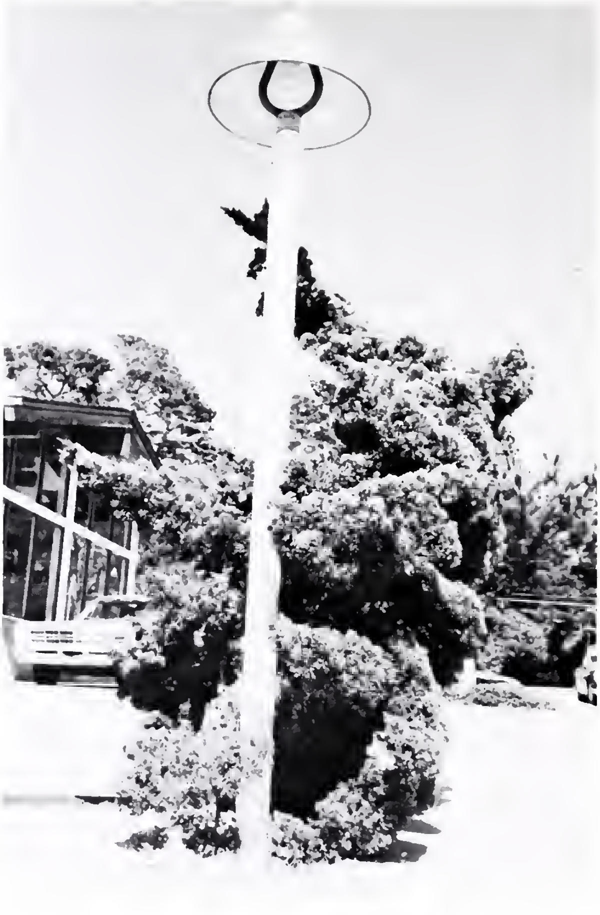
and inner fabric of most trees and shrubs, frost, snow and ice start to play their role in nature's theater. Late in the season, frost coats every branch, twig and blade of grass in a light airy manner. Form then becomes most conspicuous, and remains so when snow falls and gives the entire landscape a smooth, mellow effect, relieved only by ice hanging in statuesque stalactites.

As winter wanes and the new life of spring begins, landscape texture and form again change. Buds swell and open to tender leaves and flowers. Then, still another phenomenon—seemingly barren trees and shrubs become clothed with leaves and the fabric takes on a new dimension.

Many times I have been in a garden and felt its beauty, and have wondered just what makes this particular landscape feel so complete. Upon close observation of people passing through the same garden, I noticed that almost everyone would mention how beautiful it was, but most of them did not know why. Then they would proceed to touch the leaves of the various kinds of plants, or perhaps bend to pick up some of the stone or wood chips used for mulches or walks. As they passed the pond, they might casually put a hand in and feel the silky coolness of the water. Not knowing, they had been led through the garden from one place to another by the skillful blending of plants and other components of a varied texture created by the landscape designer. It takes a master of sight and touch to blend the ever-changing seasonal forms and textures of plants into a beautiful landscape. ◆

The starkness of winter is dispelled by spring's flowering beauty—this from Yulan magnolia (*Magnolia denudata*), which was photographed by M. M. Graff on April 20 in the Brooklyn Botanic Garden.

The sinewy trunk of an aged trifoliate-orange (*Poncirus trifoliata*) is evident all year.



Frederick McGourty, Jr.

UNDERNEATH THE LAMP POST

THE BEAR holding up this lamp post in Carmel, California is an unpruned Hollywood juniper (*Juniperus chinensis* 'Torulosa', more correctly known these days as *J. c.* 'Kaizuka'). This small evergreen tree assumes picturesque shapes in the western landscape, and no two specimens are quite alike, but each can capture the eye in its own inimitable way. Hollywood juniper is sometimes placed in the foreground of a white stucco wall, where it can be striking if the wall is of good size. In San Francisco's Chinatown, it is even planted in wooden tubs in front of shops. Foliage: rich green, mop-like clusters (not prickly). Fruits: light blue, resembling berries. Height: 15 feet or more; often slightly broad in youth, narrower at maturity. Pruning: form may be accentuated, but most people enjoy this tree as is. Allow ample room for it to develop and it may not ever have to be pruned. Winter hardiness: associated with mild climates, but grown successfully at least as far north as Boston and in East Lansing, Michigan.

"Our expressways . . . still planted as a 25-mph estate road . . ."

KINETIC CONSIDERATIONS ON PLANTING FOR HIGHWAYS AND ROADS

Dean A. Johnson

TODAY is a time of movement, speed, mobility — faster than ever before, and gaining momentum. A fine opportunity exists to do away with the static approach to plants as objects only to be viewed and, instead, to use them in a dynamic way to complement and direct this momentum. Little has been made of this approach to date. Observe our expressways, the very essence of rapid mobility; yet they are still planted as a 25-mph estate road or a rose garden that has one of each variety available.

The dictionary defines *kinetic* as 1. pertaining to motion; 2. caused by motion; and 3. characterized by movement. In the case of plants, kinetic action is caused by the viewer moving past them at different speeds and angles. By manipulating the size, spacing and direction of plants, we can actually affect his response. However, these manipulations must be in the nature of a broad stroke, particularly when we consider high-speed movement and realize how limited is the human eye's perception. To bring the various architectural elements and their surroundings into sharp focus, we should start with the understanding that the human eye's width of field is only 18° each way.

In the approach to plantings for people who are literally "on the go" there are three basic movement groups to consider:

I. Walking	**II. Cycling**	**III. Driving**
0–5 mph	5–25 mph	25–75 mph

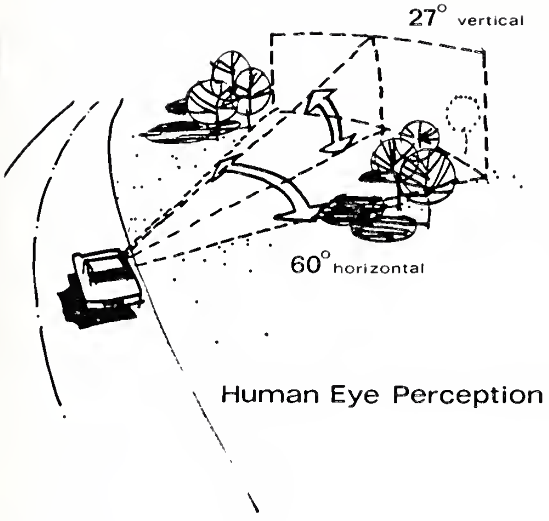
When a person is walking, even at a fast gait, most of his attention is given to detailed objects in the foreground, and he has considerable time for comprehension and thought. Burle Marx, the well-known landscape architect of the tropics, recognized this when he designed the sinuous curves of varied ground covers for a park.

A cyclist usually fixes on middle-distance objects, although this can vary greatly with speed. Driving involves a different sort of perception, because the motorist—for safety as well as reasonable comprehension—must heed what is far ahead. As a car goes faster, the distance of vision should also increase.

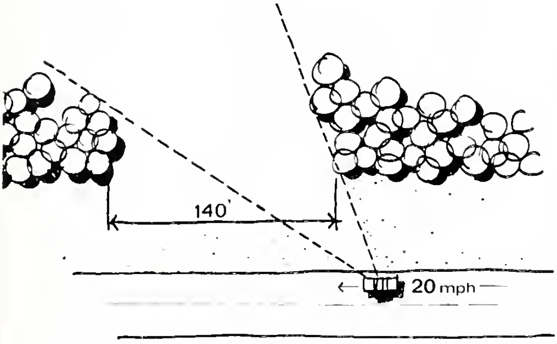
Because America is a land of automobiles and surprisingly little systematic thought has been given to influencing a motorist's reactions by roadside plant-

Arthur E. Bye, Jr.

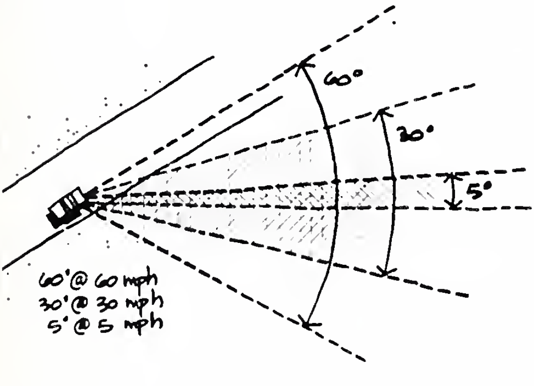
Majestc European beech in Holland give the appearance of a wall—an outdoor vertical space which directs and guides.



Human Eye Perception



7 x Speed = Length of Opening



Angle/Speed Ratio

All drawings by Richard K. Dee

ings, let's concentrate on that third category—driving. At the same time, we may note that the kinetic landscape principles applying to motorists can also apply to the other groups, although for pedestrians and cyclists, greater attention must be devoted to the branching habits of trees, their density, and leaf color and size.

First, several facts about automobile speed and the driver's comprehension of his surroundings. Highway engineers have found that the length of clearing necessary to provide a 5-second view is equal to seven times the speed of travel. To create a 10-second view, the length of clearing must be doubled, for a 15-second view it is tripled, and there are commensurately greater lengths as speed increases. Engineers have also found that the angle necessary to provide time to appreciate a vista from a specific point on a highway alignment is directly proportional to the speed. The desired viewing angle also moves forward as one's speed increases.

Deciduous trees and evergreens are the most effective types of plants there are for creating on a large scale such diverse things as directional indicators, sequential movements, or relative distances. These elements can be defined or expressed by the number and arrangement of the trees, the distinguishing characteristics of the particular trees that are used, and the position and speed of the viewer in relation to the trees.

In road plantings, the effect that the landscape architect achieves is above all dependent on driver position and speed, and changing them is seldom within the designer's control. However, one important point: as speed increases the perception of the viewer enlarges on a geometric scale so that broader strokes and clearer intentions must be made to capture his attention and make him more keenly aware of the surroundings as well as his place in them at any moment.

Through spatial sequence and the massing of trees a viewer can be given a sense of position in space, because he interprets his speed from stable objects along the highway and their proximity to himself. The kinetic variations that are employed ought not only to be pleasing to the eye, they should also provide a sense of orientation and progress toward an ultimate point.

Not long ago, two landscape architecture students from Harvard University completed a research project which contains information pertinent to kinetic viewing. (Jacobs and May, *Visual Analysis of Landscape Development*) They observed that the ability of the eye to absorb and classify what it is seeing depends on the complexity of the plantings. Another point has to do with the degree of transparency a tree permits, which is to say, its capacity to let the viewer see through it to an object that is beyond. The degree is dependent on the tree's density of foliage. This may vary from relatively transparent (sumac, locust) to translucent (ash, oak), to opaque (cedar, arborvitae). By varying the complexity and transparency to different degrees, a range of effects can be created. The ramifications of this are endless and exciting.

Here are some kinetic variations that may be used to provide a measure of order in roadside plantings.

Sequential

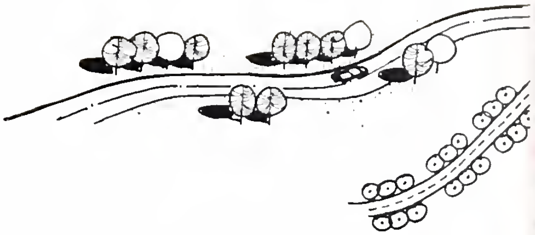
A continuous or connected series of plantings gives the highway a definite rhythm and tempo. Once a cadence is created, the driver knows when to expect changes by variations in the sequence.

Alternation

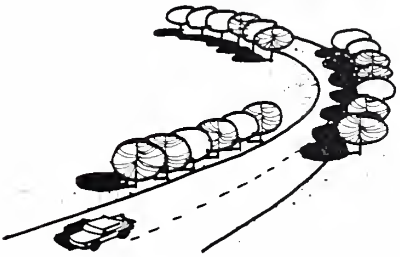
This consists of repeating a series of plantings according to the turns in the road. Trees are situated on the outside of curves to give a sense of direction. Alternation may also be used to emphasize a view by leaving the scenic area open and planting the side opposite as a backdrop.

Hierarchical

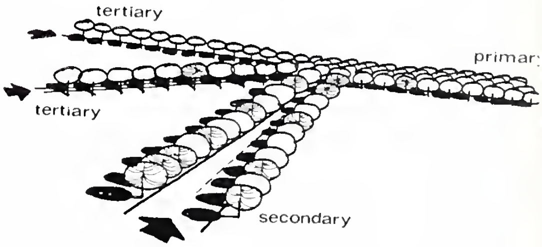
Differences of street sizes can be stressed by planting each with a particular tree form (columnar, pyramidal, round-headed) or kind (crabapple, beech, etc.); also by spacing nearer or farther



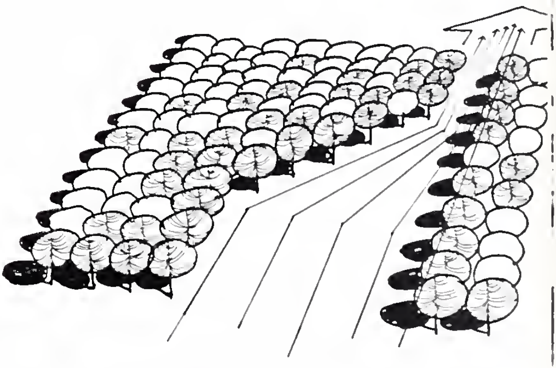
SEQUENTIAL



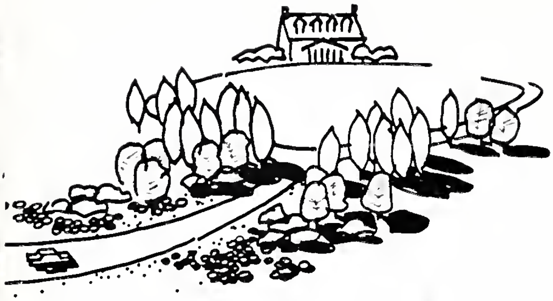
ALTERNATION



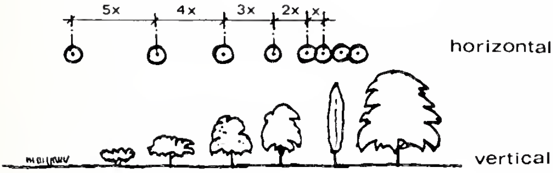
HIERARCHICAL



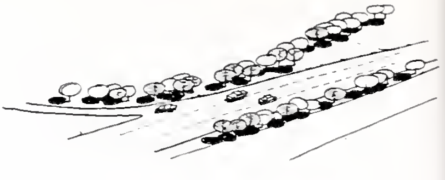
DIRECTIONAL



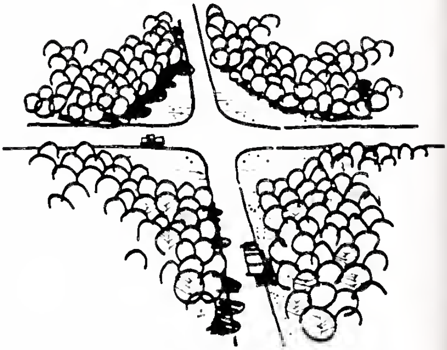
1 PROGRESSIONAL



2 PROGRESSIONAL



CONTRACTION



EXPANSION

apart. Wide streets might have double or triple rows, and the density of trees could vary according to even one side of the street. Hierarchical planting has received very little attention in cities, but it is a logical method to the "ranking" of roads and can be a psychological aid to the motorist.

Directional

Groups of trees in a careful pattern along a street can heighten the sense of direction for both motorist and pedestrian. An angled wall of trees can be as directional as a building facade. This kinetic variation may be put to work in imaginative ways and has special meaning for today's cities, as more and more people become concerned with the quality of their surroundings.

Progressional

An intersection or other point can be given emphasis to the motorist by this method. As a strategic area is approached the spacing of trees or shrubs will decrease, with the highest density occurring at the point of culmination. Variations on a theme: increase the number of tree rows as the terminus nears; use different kinds of plants that have different eventual heights, but make sure that there is a progressional relation to their heights.

Contraction/Expansion

Shortening or lengthening the space between trees (or groups of them), as well as making the groups larger or smaller, influences the sense of traffic direction. It can also psychologically encourage the driver to reduce speed as he feels a space getting tighter, or to go faster as it becomes open. ◆

Suggested Further Reading

Derek Clifford, *A History of Garden Design,* rev. ed. (New York: Praeger, 1966).

Paul Zucker, *Town and Square* (New York: Columbia University Press, 1959).

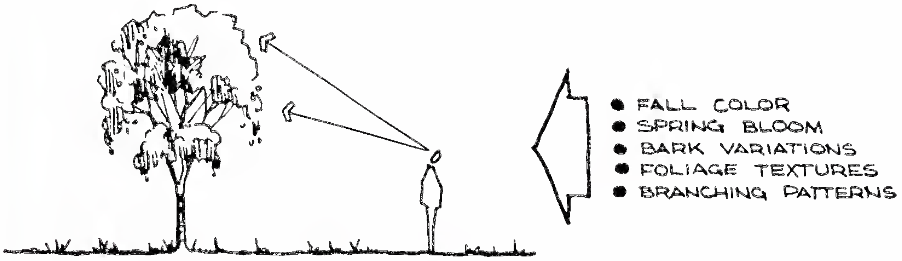
Vegetation and Environment Design (Department of Landscape Architecture and Regional Planning, University of Massachusetts, Amherst, Mass.)

OTHER BOTANIC GARDEN HANDBOOKS ON LANDSCAPE DESIGN

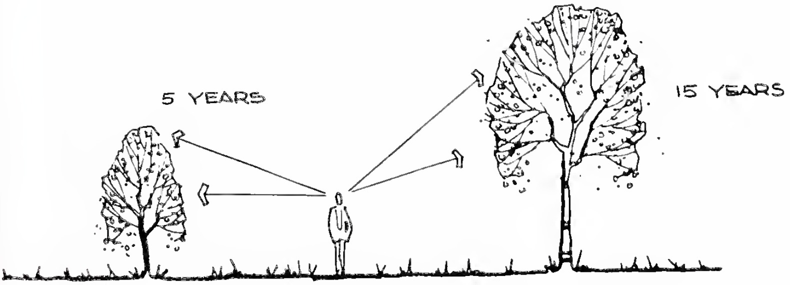
IF this special-feature edition of PLANTS & GARDENS has been of particular value to you, the Editorial Committee would call your attention to two other Brooklyn Botanic Garden Handbooks on architectural themes. *Creative Ideas in Garden Design* is essentially a Handbook of fine photographs selected to show the many imaginative ways to plant an outdoor area as well as how to bring greater beauty to the environment. *Garden Structures* provides easy-to-follow construction plans for terraces, paths, fences and other architectural features; it also shows how to use these elements around the home to bring out the best qualities of a garden.

Also of appeal for readers who want to learn more about the man-made landscapes of other lands: *Japanese Gardens and Miniature Landscapes;* and *Gardens of Western Europe*. For information on ordering any of these Handbooks, see the back cover of this issue.

TREE THOUGHTS



OPPORTUNITIES FOR VARIETY



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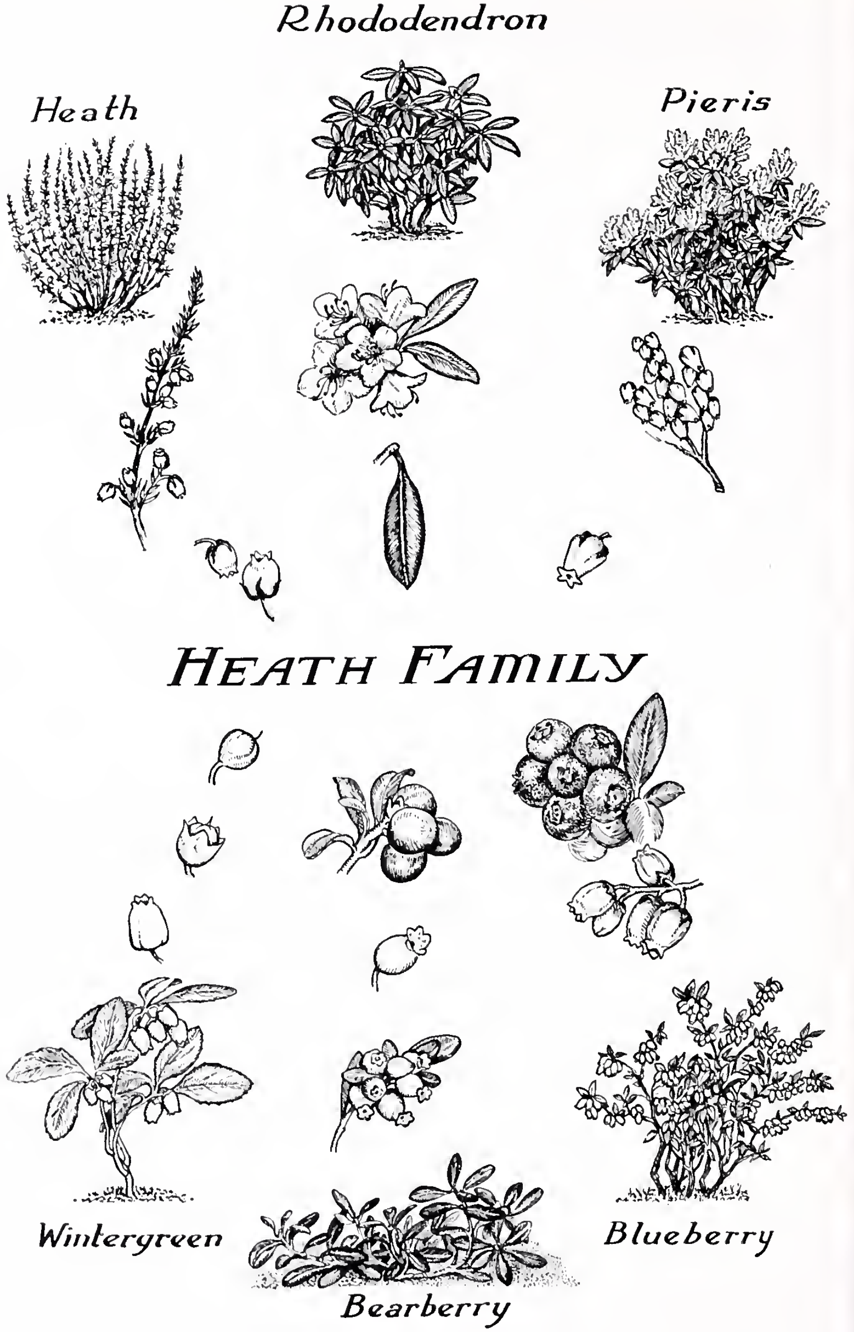


Rhododendrons and their relatives—all members of the heath family (Ericaceae). The drawing shows some typical family members and their flowers and fruits: Heath (*Erica*), *Rhododendron; Pieris;* Wintergreen (*Gaultheria procumbens*); Bearberry (*Arctostaphylos uva-ursi*); Blueberry (*Vaccinium*). See also pages 11 and 87.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

Rhododendrons, azaleas, pieris, blueberries and their relatives—some 2,100 species of them—comprise the Heath Family, one of the most ornamental of all groups of plants. The Heath Family, or Ericaceae as it is known botanically, is represented throughout the world, with a substantial proportion of its members native to the cool temperate zones and to the mountainous parts of the tropics. Several species are subarctic, and a few, like the true *Andromeda* and *Ledum,* may be found in northern reaches around the globe. A relic stand of *Erica arborea,* one of the heaths (in the narrow sense of the word), was discovered a few years ago in the Tibetsi Mountains of the central Sahara. A population explosion of sorts has occurred at the very southern tip of Africa, where over 600 species of *Erica* have been recorded, and a similar concentration of rhododendrons is known to grow wild in the Himalayas. For the garden, the hybridizer and horticulturist have created and selected many hundreds of varieties among ericaceous plants.

The task of Guest Editor Gordon Jones and the 24 Contributors he has brought together for **RHODODENDRONS AND THEIR RELATIVES** has been to choose a relatively few of the most beautiful kinds of plants from an enormous number with much greater-than-usual beauty and appeal; also to give background and advice on how to grow them in the garden. Let us take this opportunity to thank them for their efforts.

Of the 200-or-so kinds of rhododendrons grown at the Brooklyn Botanic Garden, the one that receives the most attention from visitors is the Korean rhododendron *(Rhododendron mucronulatum)*, a deciduous sort (but not a decidous azalea). The flowers in the typical form of the Korean rhododendron are a rosy-mauve, and sometimes they are sparsely produced, especially when the plant has been growing in shade. Actually, the time of year is why this plant is so popular here: it blooms in March and early April and the flowers show an almost neon intensity in the generally still colorless landscape of the Botanic Garden. Often there will be a recurring bloom in the long mild autumns that New York City is apt to have, and occasionally a few flowers may be seen in the middle of winter. Obviously, the Korean rhododendron is appreciated in other areas for its early spring display, as it is a favorite on many of the lists (which begin on page 13) submitted by our regional contributors.

In certain parts of North America, rhododendrons and their relatives cannot be grown—or with only fair success. Most of them do not thrive where rainfall is sparse, nor where summers are excessively warm and winters excessively cold and windy. Yet, while they are at their best in the acid-soil regions of the East and West Coasts, there exist a surprising number of pockets between these major areas where some kind—or several kinds—are being cultivated. If you have not discovered this diversified plant group, here is an invitation to wander through a new world of garden beauty. If you are a hobbyist, this Handbook will provide you with information on other first-rate ericaceous plants to help complete your collection.

Frederick McGourty, Jr.

Editor

Mr. Howard Phipps of Westbury, New York, has, by gift, made possible all color illustrations in this Handbook.

RHODODENDRONS

A Genus of Surprises

David G. Leach

DIVERSE they are, wildly so, but it becomes a little more meaningful to make a comparison: if humans varied in stature as much as do rhododendrons, a good part of the population would be half a mile tall!

From 2-inch alpines atop the Tibetan Himalaya to oak-like trees festooned with orchids in the monsoon moisture of upper Burma; from minute matchstick leaves to elephant-ear monsters a yard long and a foot across; from vine-like epiphytic sorts rooted in a bit of debris high in the tree crowns of southeastern Asia's forests, to squat, square undershrubs on the rocky mountain slopes which loom above them; from giant scented flowers the size of a dinner plate to nailhead mini-blooms. And the color range: yellow and orange, scarlet and pink, mauve and near-blue, and white. The sorts with white or pastel-colored flowers are often fragrant. Some of those most alluringly scented contain in their nectar one of the world's deadliest poisons, acetylandromedol. The brilliance of those of stronger hue attracts insects to pollinate them.

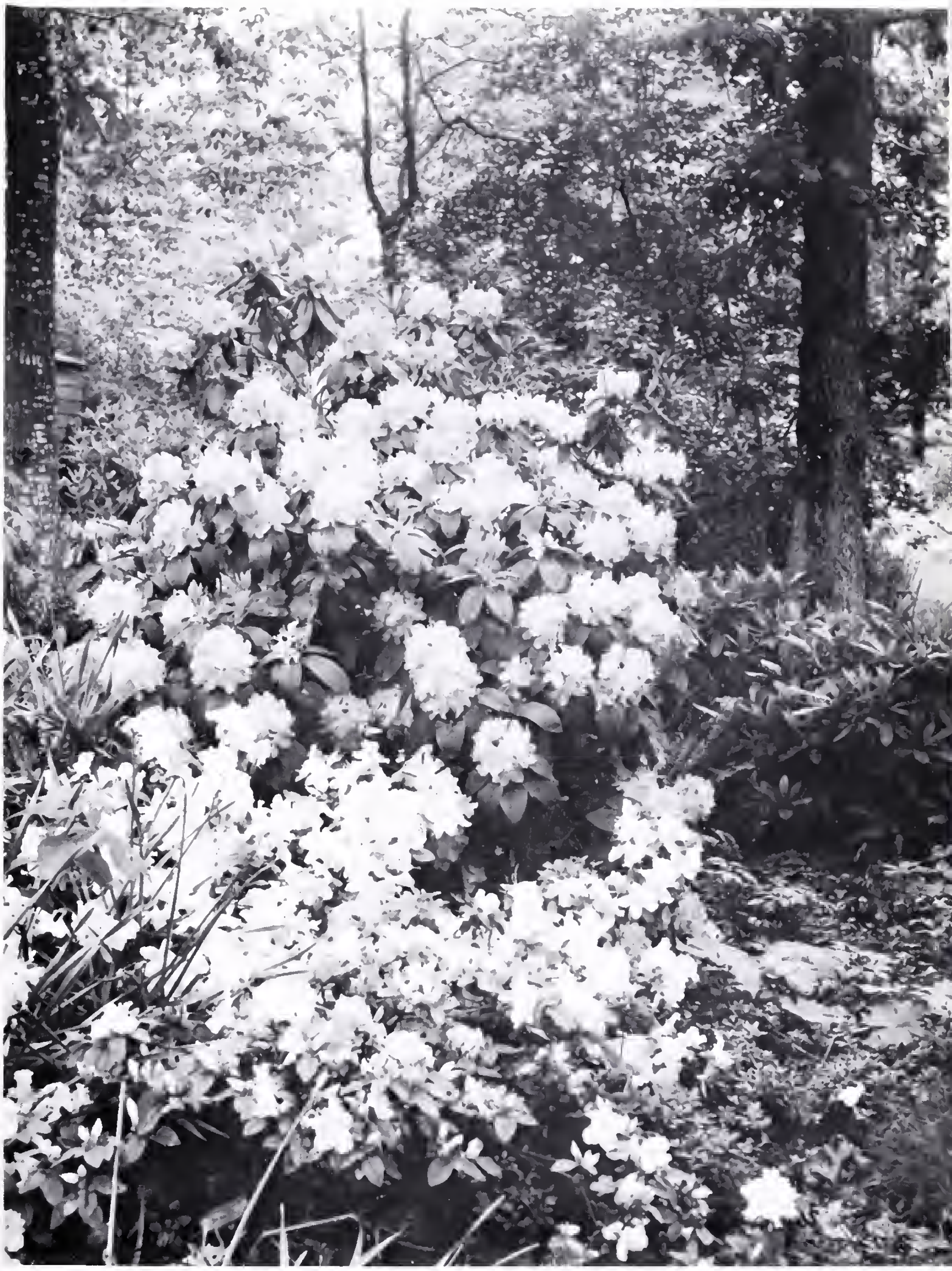
The uses to which they have been put are a reflection of their own protean prodigality. In the Orient, rhododendron leaves are smoked for the relief of asthma, and snuff is made from them in India. Italians make a tea from the leaves of the alpen-rose (*Rhododendron ferrugineum*) which is used for relief from arthritic pain. Siberian foresters get drunk on a similar infusion made from a different species. Until a few years ago North Carolina mountaineers extracted a brown dye from the rose bay rhododendron (*R. maximum*) and used its wood to make pipe bowls.

Where do they all come from, nearly a thousand species? About 635 grow at altitudes of 4,000 to 18,000 feet in the mountain lands of romantic legends: Tibet, Nepal, Sikkim, Bhutan, India, Burma and on into southwestern China. A satelllite concentration of 261 species inhabits Malaysia. A few have spun off the Chinese coast to the Japanese islands. There are only 29 in the United States, and a few in Europe and the Mideast.

Rhododendrons are primarily plants of the northern hemisphere, of moderate temperatures and high humidity. A maximum summer temperature of 70° F., a rainfall of 75 inches or more, and with a winter dormant period are ideal. In Borneo, rhododendrons grow at sea level, an exception to the usual. The best growing conditions in the United States exist in the Northwest.

Only a tiny fraction of the world's rhododendrons are hardy enough to be grown in the northeastern United States. Those that are, grow easily and well in the rectangle bounded by Cleveland, Montreal, Portland, Maine and Washington, D.C., with a southward extension on the slopes of the Appalachian Mountains through North Carolina. This corresponds, roughly, with the distribution of rhododrendrons in nature, which in turn correlates almost exactly with the acidic soil region of the United States to the point southward where high summer temperatures become the inhibiting factor. In the Midwest and the deep South special methods of cultivation are required.

Most gardeners can readily divide rhododendrons into three large categories: the familiar tall, portly evergreen shrubs with large leaves either smooth or hairy, but never scaly; the much less familiar sorts with minute plate-like scales such as the Carolina rhododendron (*R. carolinianum*) which has smaller leaves and finer texture; and, of course, the azaleas, which have five to ten stamens, often strigose



Photographs by Marjorie J. Dietz

Rhododendron 'Roslyn,' a lavender-blue hybrid with more blue tones than lavender in its flowers, and a white Glenn Dale azalea in a woodland garden.

Early-flowering rhododendrons in Holland's Keukenhof Gardens at Lisse are elegant companions for the surrounding spring bulb plantings. They benefit from the atmospheric moisture created by the large pool in their background.

hairs and flowers which develop from terminal buds. Azaleas are hard to differentiate in brief description, precisely because they *are* rhododendrons, vary greatly, and include some "hippie" species which rebel against conformity. But almost any gardener distinguishes an azalea at a glance. They are just one kind of rhododendron, but the distinction can not be made on the basis of evergreenness. There are quite a few evergreen azaleas just as there are a good many deciduous rhododendrons.

Taxonomists have tried to organize this disastrously chaotic throng into 43 groups of related species called series. The effort has been reasonably successful for casual uses but it has never been possible to devise consistent keys to all of the series.

Rhododendrons began their steady rise to garden eminence in 1811, when the majestic scarlet globed tree, *R. arboreum,* was sent to England from India. It was soon followed by other spectacular sorts now famous for their beauty, and hybridizing began in England at a frantic pace. In the 1830's the showrooms on Regent Street in London were jammed with visitors eager to see the newest hybrids on display, and the nursery lists were soon featuring scores upon scores of cultivars, most differing little from one another. This fashionable pursuit became even more furious following the introduction by Sir Joseph Hooker in 1850 of 45 new species discovered in Sikkim.

By 1900 about 300 species of rhododendrons were known to exist and 35 were in cultivation. Then came one of the most astonishing chapters in the annals of plant exploration. Between 1900 and 1940 more than 600 new species of rhododendrons were discovered in southeastern Asia by Ernest Wilson, George Forrest and their successors. Three hundred and twelve new species were found in one decade. George Forrest alone introduced the incredible total of 260.

After World War II, attention shifted

to the Malaysian rhododendrons (see page 36). *R. toverenae,* with sumptuous fragrant white blooms 7 inches across, was among them. There were many more. In the 25 years since the war there has been repeated, on a smaller scale, in New Guinea and Indonesia, the same surprising bounty of new species that characterized the mainland rhododendrons of Asia in the first quarter of the century. Scores of previously unknown sorts have been found.

There are about 20 of the world's rhododendron species which are important horticulturally in the eastern United States, and about 140 wild sorts are prominent on the West Coast and in England. The Catawba rhododendron (*R. catawbiense*) from the Blue Ridge Mountains has, through breeding, supplied the hardiness for nearly all of the garden hybrids popular throughout the Northeast. Close to the East Coast, a species from eastern China, *R. fortunei,* with big clusters of 4-inch scented pale pink blossoms, has lent its name to a race of hybrids not quite so hardy which are characterized by an earlier season of bloom, novel colors and larger flowers which are often fragrant. The best of these have been named and are available from specialist nurserymen. The Dexter hybrids are in this category.

The single most popular species among hobbyists is *R. yakusimanum.* Introduced to gardeners in England in 1947, it was the great hit of the Chelsea show that year. The clamor for plants has never subsided, either in England or in this country, where, until recently, nurserymen have been taking orders for delivery two and three years in the future. Now it is just starting to become known to the gardening public. *R. yakusimanum* has received the American Rhododendron Society's highest rating for both form and flower.

Tens of thousands of rhododendron hybrids have been produced since their purposeful breeding began in England in 1810. The standard rhododendrons of commerce in the Northeast were produced about a century ago by Englishman Anthony Waterer. The two plants of the American Catawba rhododendron which he used in the 1860's to impart hardiness are still growing at his famous Knap Hill Nursery, their gnarled, ancient limbs supported by posts. The Waterer hybrids are often called "ironclads," a reference to their survival at the Arnold Arboretum after the unexampled cold during the winter of 1918.

A pink rhododendron at Sandwich, Cape Cod, typical of many Dexter hybrids.

The most productive American pioneer in the field was the late C. O. Dexter of Sandwich, Massachusetts. In the 1930's he produced myriads of larger flowered, earlier blooming hybrid seedlings, some of color without precedent in the East. The best of these have been gradually isolated through the years, named, and propagated commercially. 'Scintillation,' a luminous pink of fine growth habit, is probably the best known.

Other Americans have carried on in the Dexter tradition. Joseph B. Gable, of azalea fame, produced an array of fine hybrids of which the striking 'Mary Belle,' with coral buds opening yellow, is in the forefront. Guy Nearing created in New Jersey the first near-blue flowered hardy alpine hybrid, 'Ramapo,' a useful dwarf already a staple in the nursery industry. 'Dora Amateis,' a fine, compact

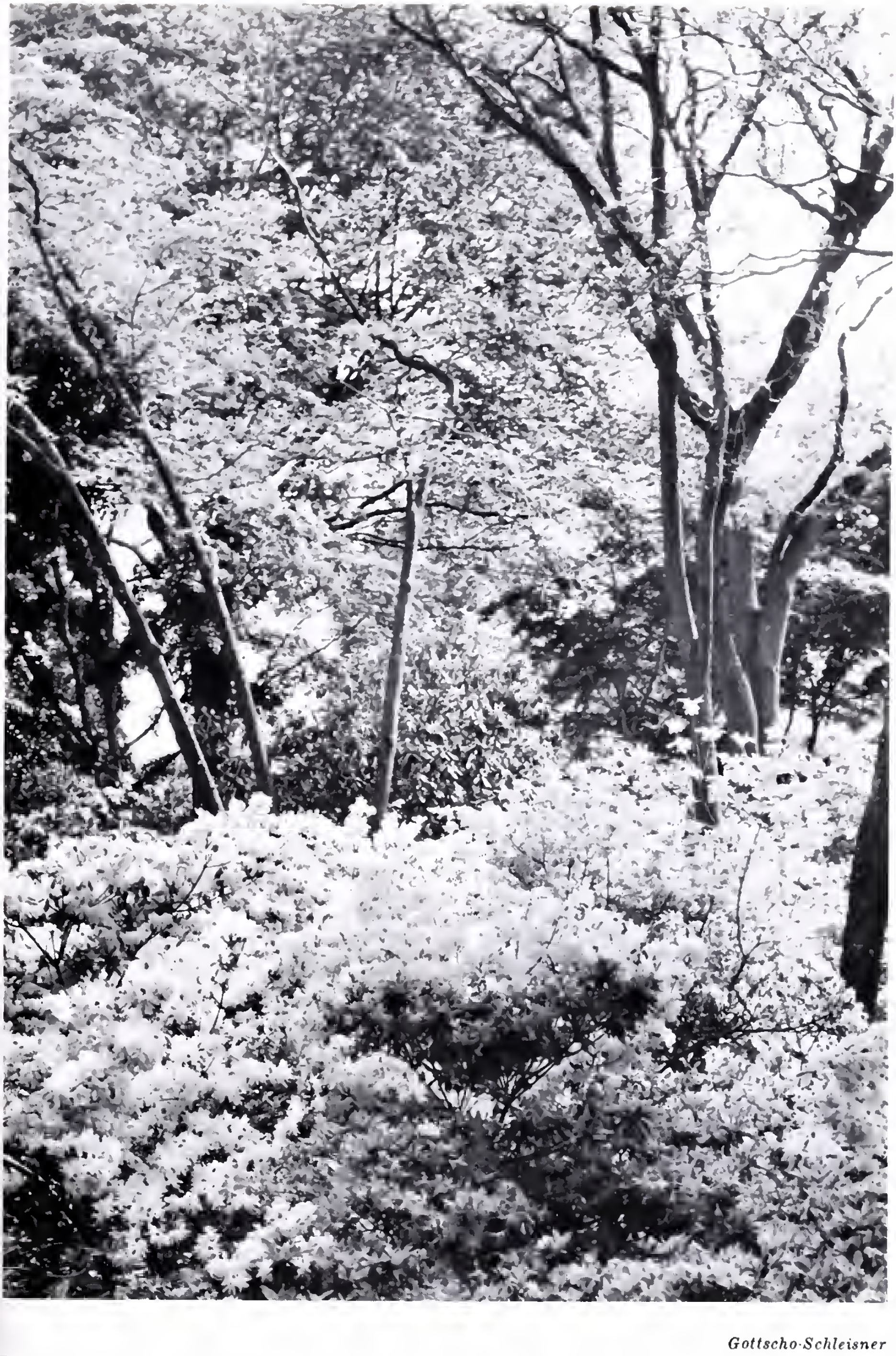
Gottscho-Schleisner

Carolina rhododendrons and flowering dogwood trees at Planting Fields Arboretum, Oyster Bay, Long Island, New York.

low growing white, came from sculptor Edmond Amateis. In Ohio Tony Shammarello originated the notable silvery 'Pink Pinnacle' and the large flowered rose 'King Tut.' This author's 'Janet Blair,' palest pinkish mauve 4-inch saucers with a bold bronze flare, and fragrant, has been a commercial success. The rhododendron hybrids now in commerce have been rated for quality and hardiness by the American Rhododendron Society.

The "evergreen" azaleas, which are really only persistent-leaved to widely varying degrees, fall into more or less well recognized groups. In order of increasing hardiness they are the Satsuki hybrids with very large, late flowers; the Glenn Dale hybrids, of which there are many, generally with big blossoms exhibited by the various clones over a long season; the Kurume hybrids, prodigious producers of small flowers, the most widely grown of all azaleas since their introduction in 1912; the Kaempferi hybrids, easily recognizable by their music-associated names; the Gable hybrids, hardier versions of the Kurumes in lavender, pink, white and red; and the Pride hybrids, derived from Gable clones, and a bit hardier still.

The most lively interest in azaleas in the last 10 years was aroused by the introduction from England of vastly improved deciduous sorts. The same Knap Hill Nursery which produced our "ironclad" rhododendron hybrids in the 1860's introduced nearly a century later a series of azaleas which startled the horticultural world with their novel colors, giant flowers 4 inches or more across and improved foliage. The pastel pinks, soft yellows, faultless whites and unusual blends and color patterns in flowers of such size were instantly acclaimed, as was a series with smaller double flowers. At the time, the popular deciduous azaleas were the Mollis hybrids, coarse, short lived, with ill-



Gottscho-Schleisner

Evergreen azaleas under high pruned dogwoods and other trees at Planting Fields.

'Pink Gumpo,' one of the popular evergreen Satsuki azaleas. The exceptionally large flowers appear in very late spring. In most years they completely blanket the low-growing, mound-shaped plants.

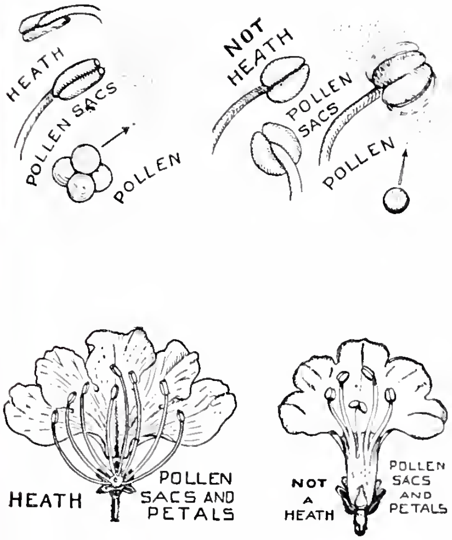
Rhododendron sutchuenense has long, drooping leaves and very early rose-pink flowers. Here it is shown with the early daffodil 'Joseph McLeod.'

smelling foliage and raw colors of limited range.

In the early 1930's Lionel de Rothschild, the great English horticulturist and international banker, obtained from Knap Hill Nursery some of their finest azalea hybrids. Already a renowned rhododendron breeder, he set to work at Exbury Estate on a colossal hybridizing program to further improve on the Knap Hill cultivars. Hundreds upon hundreds of thousands of seedlings were raised, year after year, but every spring Mr. de Rothschild kept only the two best of each color. The mammoth pyres in which the countless rejects went up in smoke each June became locally famous. Crossing like colors only, the two best of each, and raising myriad seedlings generation after generation, there finally emerged 104 named clones which met the Rothschild standards.

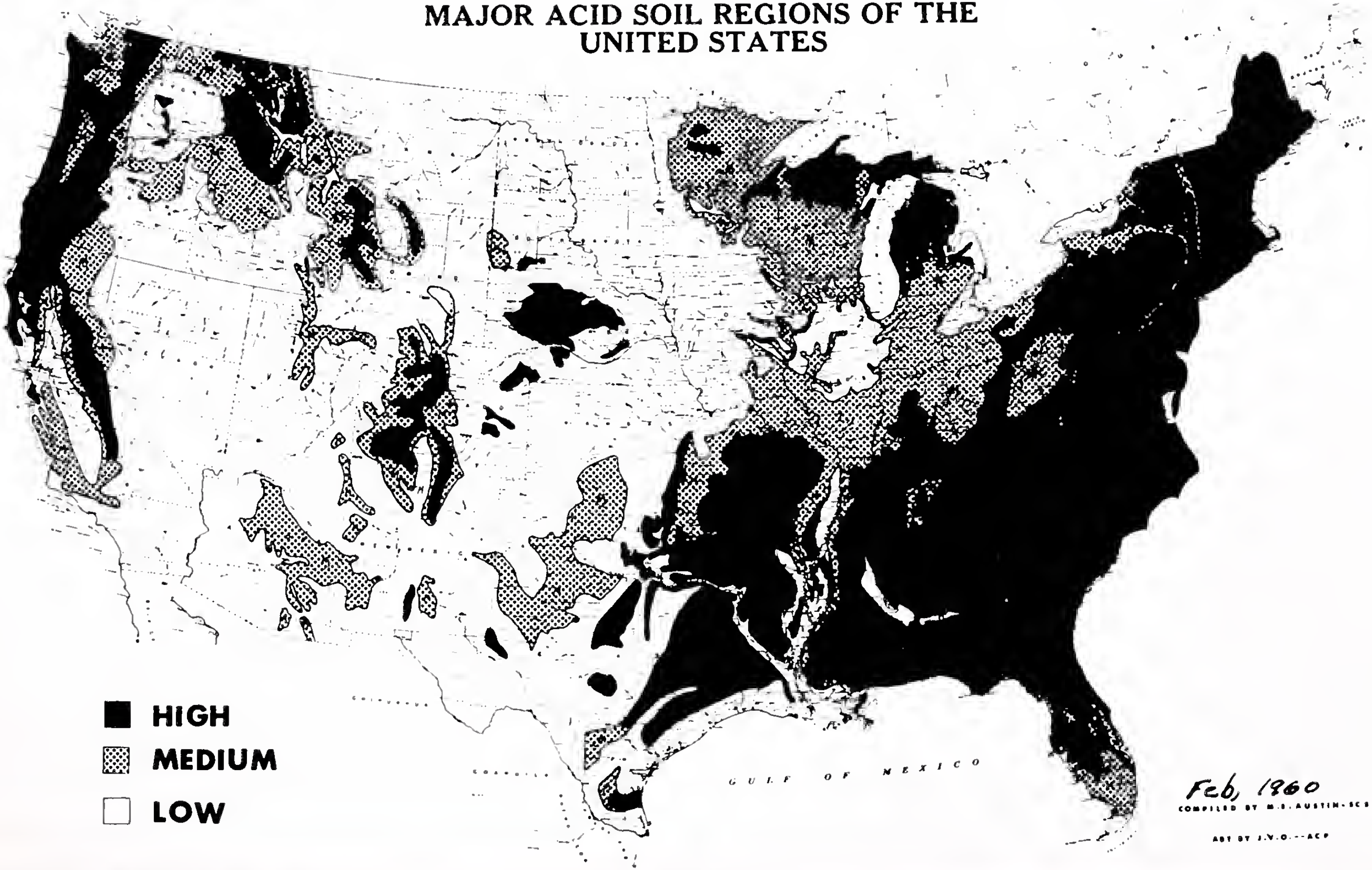
The flowers of the Exbury hybrids are often 4 inches across, with extra-broad corolla lobes. They are clustered in rhododendron-like trusses, and some of them are fragrant. Some also have brilliant fall foliage. But the most remarkable thing about them is their colors: pale orange, overlaid with rose and with a darker orange flare; flesh pink, with a reticulation of deeper pink and an orange flush; salmon, with a yellow patch; pale orange and gold, flushed olive; white, with pink-flushed margins; apricot and orange; brilliant yellow with a greenish heart; orange with pink undertones and darker stippling; flame, suffused yellow, and so on. There are many fine Knap Hill cultivars, some of them fully equal to the Exbury clones, and some that are unique, but most specialists consider the Exbury originations to be generally superior.

Some years after Lionel de Rothschild began his hybridizing, Edgard Stead of Christchurch, New Zealand obtained some of the English Stock and started the development of an independent strain at him Ilam estate. His emphasis was on large size, ruffled flowers, fragrance and the texture of the blooms, and he succeeded in all of his goals. In the orange-to-red category, the Ilam hybrids are the finest, particularly for American gardens, because of their heavier flower substance. The flowers are immense, larger than their British counterparts in this color range, and many are both frilled and fragrant. Some bloom very late, into the middle of June. The Ilam strain was further developed by Dr. J. S. Yeates, a geneticist at Palmerston North, New Zealand. From seeds received from him the author grew some thousands of plants and made selections which were named 'Canterbury,' 'Maori,' both orange, and 'Spring Salvo,' an early red. James Wells, of Red Bank, New Jersey also named about a half dozen of the author's selections. The Ilam hybrids are unsurpassed in their colors but their range is sharply limited. There are none of the subtle pastel blends and unusual combinations which distinguish the Exbury hybrids. There, perhaps, is the wave of the future for an American breeder. ◆



The many kinds of plants in the Heath family may differ in their outward characteristics to most gardeners, but they are held together as a family by a combination of features: 1. The pollen sacs open by pores at the tip, rather than by lengthwise slits as in most other families. 2. Each particle of the powder-like pollen is composed of four pollen grains joined together (this can be seen only under a magnifying glass). 3. The stalks on which the pollen sacs are mounted do not grow upon the petals as they do in many other families (particularly when the petals are grown together at their edges as they are in most members of the Heath family). 4. The number of compartments in the seed capsule or in the berry is the same as the number of petals (or greater), rather than fewer as in most other plant families. (See also page 2 and page 87.) The various members of the Heath family are not entirely uniform even in these characteristics.

MAJOR ACID SOIL REGIONS OF THE UNITED STATES



Feb, 1960

COMPILED BY M.E. AUSTIN-SCS

ART BY J.V.O.--ACP

A Guide which includes species, hybrids and azaleas . . .

FAVORITE RHODODENDRONS AND AZALEAS BY REGION

THE UPPER NORTHWEST—Fred Robbins, Puyallup, Washington

10 Rhododendron Species

Rhododendron augustinii—Funnel-shaped flowers, blue to dark rose-blue, in clusters. Blooms most abundantly at maturity. In 20 years: 15 feet high, 12 feet wide.

R. bureavii—Flowers white with crimson spots, in compact truss. Thick leathery leaves with rusty woolly indumentum on undersides, especially noticeable on new growth. In 20 years about 6 feet high, 7 feet wide.

R. callimorphum—Flowers soft rose-pink. Compact plant, about 4 feet by 5 feet at 20 years, with branch structure in layers.

R. campylocarpum—Flowers, about 1 to 2 inches long, in clusters. Canary yellow in the best form. The brightest yellow rhododendron in the garden. Height at 20 years: about 7 feet, in pyramidal shape.

R. fulvoides—Campanulate flowers, white with a crimson spot in throat. One-year branches are covered by a brown-buff indumentum; tawny indumentum also appears on leaf under-surfaces.

R. impeditum—Pairs of funnel-shaped flowers, mauve to dark purplish-blue. Height in 20 years: about 10-18 inches. A popular rock garden subject and good companion for *R. keleticum* and *R. radicans*.

R. keleticum—Broad funnel-shaped flowers, deep purple-crimson to lavender-crimson with red spots. Two forms: one reaching 12 by 24 inches in 20 years; the second, 4 by 20 inches. Aromatic foliage. Both make excellent rock garden subjects.

R. russatum—Funnel-shaped flowers in clusters, deep purple to intense violet-blue with white throat. Height, 4 feet, in 15 years.

R. thomsonii—Campanulate flowers in loose truss of 8 to 12 flowers; deep, rich blood-red color in best forms. Takes several years to bloom. Small tree or shrub of varying heights, from 12 to 25 feet.

R. yakusimanum—About 10 campanulate flowers in compact truss; deep pink in bud, pure waxy white in full bloom giving an apple-blossom effect. Brown felty indumentum on undersides of leaves and new growth. Slow growing: in 20 years may be 3 feet by 5 feet. There are superior forms available, and the species is being used in hybridizing.

10 Rhododendron Hybrids

'Alice'—Clear deep pink flowers in a large compact truss; rich green foliage. Compact habit. Endures a good bit of sun. About 15 feet in 25 years.

'Azor'—Funnel-shaped flowers, deep salmon pink with lighter streaks and some yellow. Blooms in late June. Plants grow to 8 feet; 10 feet wide.

'Blue Diamond'—Lavender flowers in small trusses, which cover plant. A small-leaved plant which endures sun. Reaches 4 feet in 20 years. Suitable for rock gardens and banks.

'Bow Bells'—Bell-shaped flowers, clear pink, in loose trusses, which cover plant. Ultimately reaches 6 feet; about 6-8 feet wide. Leaves, 3 inches long, cover plant from top to bottom.

'Carmen'—*R. repens* hybrid. An abundance of dark red flowers in clusters of three to four flowers. Leaves, an inch long, show lighter green veining on top. Grows to 2 feet by 4 feet in 20 years.

'Jean Marie de Montague'—Funnel-shaped flowers with crinkled edges of bright scarlet, in a compact truss. Rich dark green leaves, 6 inches long. Needs protection from afternoon sun.

'Lady Roseberry'—The tubular flowers, rosy red, hang from a pendulous truss. The plant is 8 feet tall, 5 feet wide, in a straggly structure. A bit tender here, but worth growing in a protected spot.

'Loderi King George'—Broadly funnel-shaped flowers, pure white with green spot at base. The most delightful fragrance of any hardy rhododendron. A large plant: 15 feet tall and 20 feet wide at maturity. Needs filtered sun and good drainage.

'Mrs. Betty Robertson'—Cream-colored flowers, widely funnel-shaped; ten or more in a truss. Attractive twisted foliage. Grows to 6 feet by 6 feet at maturity.

'Naomi'—Heavy, waxy flowers, pink tinged with yellow, slightly fragrant. At maturity: 10-12 feet.

Azalea Selections

Gable Hybrids—'Rosebud,' 'Caroline Gable' and others. Evergreen foliage.

Knaphill and Exbury Hybrids—Outstanding deciduous azaleas. Good fall color from foliage. Large flowers, in clusters of 15-30 per truss. Recommended are 'Cecile' (salmon-pink); 'Strawberry Ice' (pink); 'Sun Chariot' (pale yellow); 'Klondyke' (copper); 'Silver Slipper' (white); 'Gold Dust' (deep yellow).

Kurume Hybrids—For borders and foundation plantings. Evergreen foliage.

Rhododendron occidentale—A deciduous azalea native to the Pacific Coast. Funnel-shaped flowers from white to pink. Good fall color from foliage.

Rustica Flore Pleno Hybrids—My choice among these old deciduous favorites is 'Norma,' with double carrot-colored flowers. Grows to 5 feet in 15 years.

R. schlippenbachii—The royal azalea has saucer-shaped pink flowers and deciduous foliage with good autumn coloring. Eventually a large (15 feet or more) shrub.

R. vaseyi—The pink-shell azalea native to North Carolina. Pink flowers.

THE NORTHWEST—P. H. Brydon, Salem, Oregon

10 Rhododendron Species

(*Note*: The adaptability of many rhododendrons and azaleas is proved by their inclusion on more than one regional list. Because of space limitations, readers are asked to refer to the first entry of such plants for general descriptions. In the case of *R. augustinii* below, the previous entry is on page 13 under 10 Rhododendron Species for the Upper Northwest.)

R. augustinii—See previous entry.

R. callimorphum—Soft rose or pink flowers on attractive neat bush, varying from 2 to 11 feet tall.

R. calophytum—Fragrant flowers from white to blush, 20 to 30 per truss. Long, dark green leaves. A large, tree-like plant, reaching 20 feet eventually.

R. campylocarpum—Bell-shaped yellow flowers on a neat plant. Grows to 3 feet in 10 years. A variable species as to color intensity and size.

R. haematodes—Tubular scarlet flowers in clusters of 6-10 flowers on a neat, mounded shrub, 2 feet high in 10 years.

R. impeditum—See previous entry.

R. macabeanum—Large, globe-shaped yellow flowers, 8-9 inches in diameter, in early spring. Huge leaves of a leathery texture. A handsome, small tree up to 20 feet or more.

R. orbiculare—Rose-pink flowers in early spring on a symmetrical plant to 6 feet. Outstanding.

R. thomsonii—See previous entry.

R. yakusimanum—See previous entry.

10 Rhododendron Hybrids

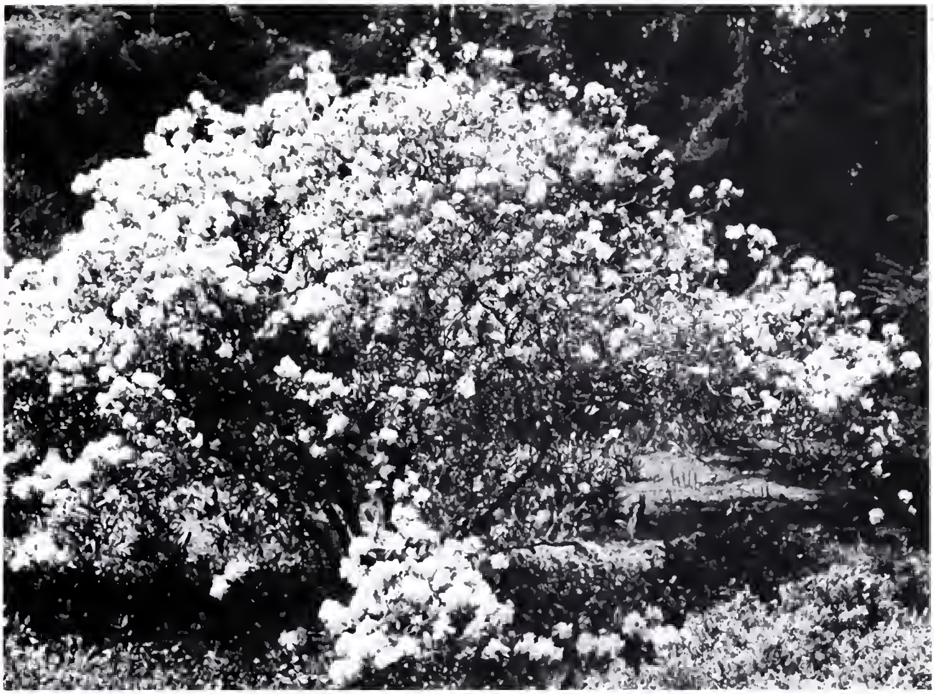
'Blue Diamond'—See previous entry.

'Bonito'—White flowers with a chocolate blotch in a large truss. Grows 5 feet in 10 years.

'Crest'—Large-flowered yellow.

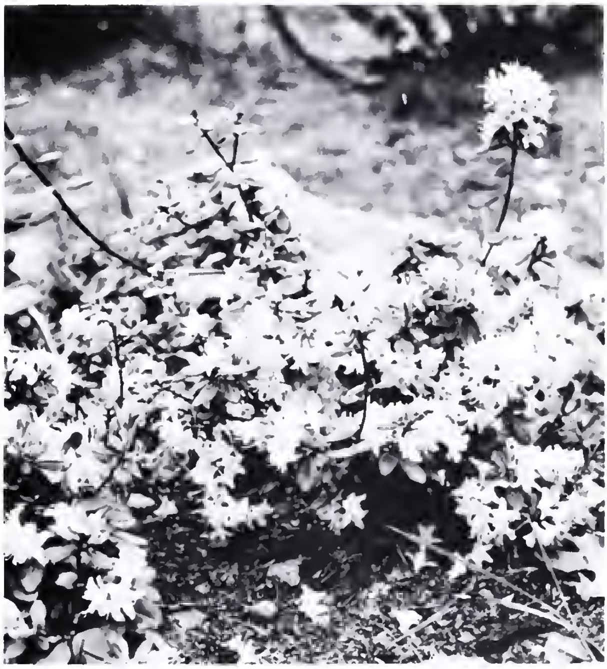
'Jean Marie de Montagu'—See previous entry.

'Leo'—Dark red. (See also Pacific South Coast below.)



Marjorie J. Dietz

Above: A large, mature specimen of the popular yellow-flowered species, *Rhododendron keiskei,* at the New York Botanical Garden. This species shows considerable variation, both in intensity of flower color and in its eventual size. Some plants are true dwarfs, remaining at 2-3 feet for many years. Others, such as the plant shown here, can reach 6-8 feet. *Right:* Equally variable and popular is *R. racemosum,* shown here in dwarf form, although taller-growing plants exist. Its small flowers, usually pink, are borne abundantly in early spring.



***R.* 'Loderi King George'**—See previous entry.

***R.* 'Loderi White'**—Beautiful frilled white flowers, their petals edged pink. Grows 5 feet in 10 years.

'Mrs. Furnival'—Pink, funnel-shaped flowers with crimson blotches. Grows to 4 feet in 10 years.

'Naomi'—See previous entry.

'Purple Splendour'—Ruffled deep purple flowers with darker blotch. Grows 4 feet in 10 years.

10 Azalea Species

R. flavum—(Formerly *R. luteum* and *ponticum*) Fragrant yellow flowers; deciduous foliage. Native to Caucasus—Black Sea regions.

R. occidentale—See previous entry.

R. pentaphyllum—Rose-pink flowers; deciduous foliage. Native to Japan.

R. quinquefolium—White flowers; attractive deciduous leaves at first edged with maroon. Grows 3 feet in 10 years.

R. reticulatum—Bright rose-purple flowers; dark green, deciduous foliage. Early-blooming Japanese species; slow growing and upright.

R. roseum—Clove-scented flowers, ranging from pink to rose; deciduous foliage. Native to northeastern N. America woodlands.

R. schlippenbachii—See previous entry.

R. speciosum—Orange-flowered, deciduous azalea native to the Piedmont areas of Georgia and South Carolina.

R. vaseyi—See previous entry.

10 Azalea Hybrids

'Cecile'—Salmon pink. Lovely. An Exbury deciduous azalea.

'Exquisita'—An Occidentale hybrid with white flushed rose flowers.

'Fedora'—Violet-red flowers; evergreen foliage. Old favorite.

'Gibraltar'—Bright burnt orange. An Exbury deciduous azalea.

'Hinomayo'—A Kurume evergreen azalea with rose-pink flowers; evergreen foliage. An old favorite.

'Hotspur Yellow'—Yellow. An Exbury deciduous azalea.

R. mucronatum 'Sekidera'—Single flowers, 3 inches across, white flushed violet-red with blotch, sometimes striped or flecked as well with same color. Mature plants outstandingly beautiful in bloom.

'Palestrina'—Beautiful white flowers with chartreuse blotch; early. Tall, vigorous plant with evergreen foliage. Outstanding. (Also known as 'Wilhelmina Vuyk.')

'Rosebud'—Pure pink flowers resembling little roses in bud and flower. Evergreen foliage. Fine, compact habit. A Gable introduction.

'Silver Slipper'—White; deciduous foliage. Knaphill-Exbury origin.

THE PACIFIC COAST SOUTH—Hadley Osborn, El Cerrito, California

10 Rhododendron Species

R. arboreum—In its best blood-red forms, one of the finest. Early blooming and tender; not for colder winter areas. Flowering-size plants unavailable; seedlings and cuttings are—and worth waiting for.

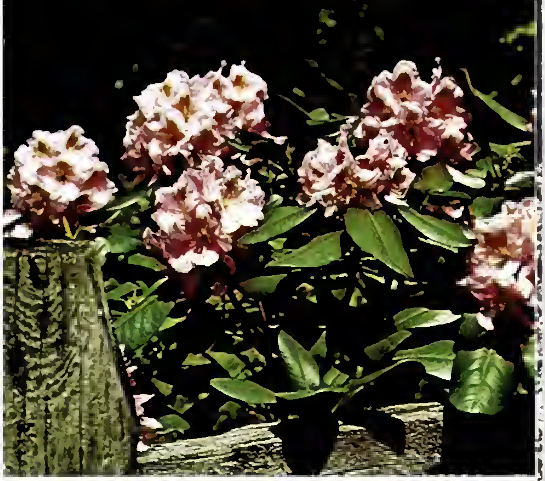
***R. augustinii* 'Barto Blue'**—(See previous entry also.) Other named forms are also excellent and preferable to seedlings. Ideal for situations where conventional-type rhododendrons would be too assertive.

R. burmanicum—The 'Cox' form with yellow flowers, is preferable. Easy-to-grow; floriferous compact shrub.

R. cubittii—'Ashcome F. C. C.' is perhaps finest of several forms. White flowers on an 8-foot shrub.

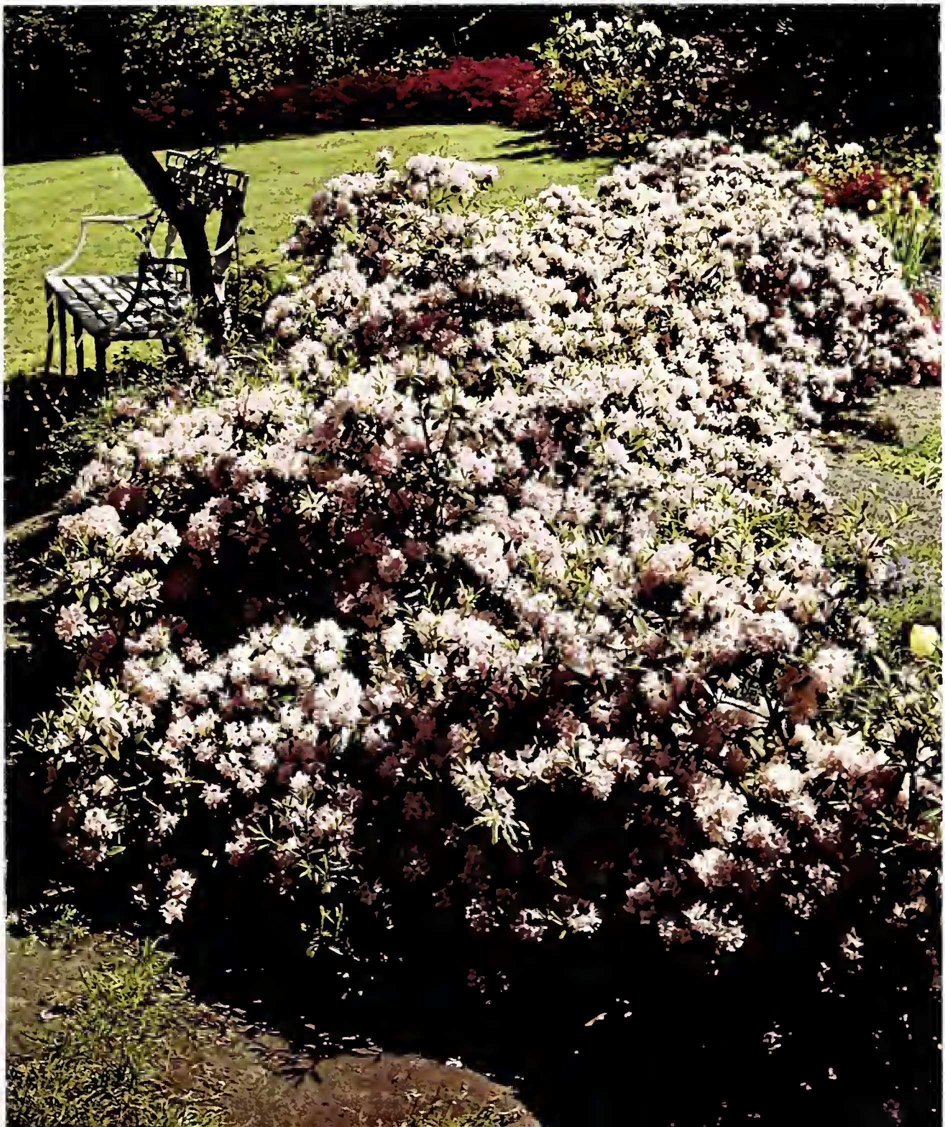
Right: Rhododendron 'Scintillation' is one of the more widely distributed of the Dexter hybrids. It has excellent foliage and large pink flowers with yellow-bronze throat markings.

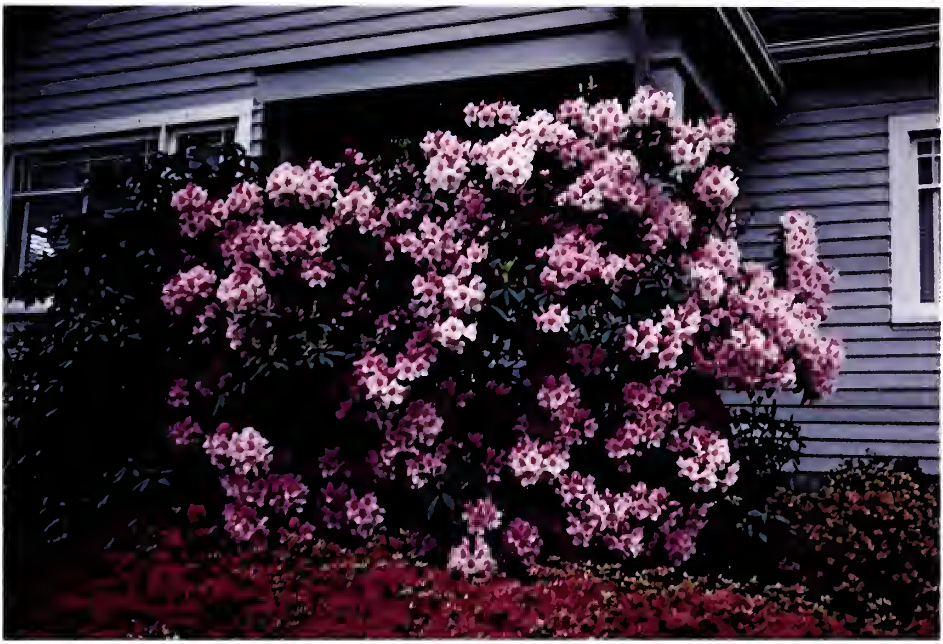
Below: Rhododendron 'Windbeam' is a Guy Nearing hybrid, notable for its abundant pink flowers, neat habit and hardiness. It is considered semi-dwarf.



Margaret Ohlander

Roche (Knippenberg Garden, New Jersey)





Planting Fields Arboretum

Rhododendron 'Pink Pearl' as it grows in a Portland, Oregon garden. It is one of the oldest hybrids and still popular, especially in warm climates.

Marjorie J. Dietz

Rhododendron 'Vernus,' one of the earliest large-flowered hybrids. It blooms with daffodils and while most trees are leafless. A David Leach hybrid.

R. davidsonianum—A variable species. The forms 'Ruth Lyons' or 'F. C. C.' are preferable. Pink flowers on an airy, informal shrub, reaching 4 feet in 10 years.

R. lindleyi—White, lily-like flowers; enormous, fragrant. Compensate for plant's thin, cane-like habit. Tender; recommended only for mild coastal areas.

R. macabeanum—See previous entry.

R. racemosum—Small pink flowers, small foliage. Usually twiggy and and compact, but there are larger forms. Seems to be at home anywhere.

R. veitchianum—An abundance of fragrant white flowers in early spring. A carefree shrub for mild winter areas.

R. yakusimanum—(See previous entry also.) This cold-climate favorite belongs in milder-weather gardens, too.

R. zoelleri—Newly introduced from the New Guinea area. Flowers, large and graceful, are an exotic blend of orange, apricot and yellow.

10 Rhododendron Hybrids

'Anah Kruschke'—Lavender flowers late in season on a compact plant with unusually deep green foliage. Has achieved an enviable record in southern California, where hot, dry air and alkaline water make it difficult to grow rhododendrons.

'Antoon van Welie'—A 'Pink Pearl' type for hot summer areas. Carefree, vigorous shrub, needing space and partial shade.

'Dame Nellie Melba'—Excellent pink flowers in April on solid, easy-to-grow plant.

'Forsterianum'—Fragrant white flowers early in season on neat plant with a mahogany, manzanita-like trunk. Blooms when young; may be grown in a container for years. Ages with incredible grace.

'Leo'—The huge late-season trusses of very dark red flowers are brilliant when shafts of sunlight hit them.

'Loderi King George'—(See previous entry also.) Demands wind protection, at least half shade and ample space here.

'Noyo Chief'—Magnificent glossy leaves and trusses of long-lasting red flowers. Coveted for foliage alone.

'Sapphire'—Lavender-blue flowers. Needs cool root-run and considerable exposure for best shape. Thrives in windy sites; "tired" winter appearance is normal (*R. augustinii* hybrid.)

'Tally Ho'—Late trusses of glowing red on neat, spreading shrub.

(Note: In lieu of a tenth choice, watch rather for 2 hybrids created for our conditions—'Lemon Mist' (small yellow flowers on dwarfish shrub) and 'Mi Amor' (immense, fragrant white flowers on a vigorous, upright shrub with sun-tolerant foliage).

10 Favorite Azaleas

'Aphrodite'—Pink flowers on a bushy shrub in a lavish display. Typifies the virtues of the best Glenn Dales, revealing why—as the plants mature—they have a growing number of devoted partisans.

'Dr. Bergmann'—Large ,semi-double orange-red flowers in spring and fall. For mild areas with protected sites.

'Gumpo'—Compact, low-growing azalea with large white-to-pink flowers. Very late. A Satsuki hybrid.

'Orangeade'—Pale orange flowers and deciduous foliage. An Exbury hybrid. Susceptible to mildew, but new systemic fungicides show promise toward easy control.

'Redwing'—Red, hose-in-hose flowers. Loose habit may be improved by pruning.

'Ripples'—Ruffled, rosy pink flowers cover plant in spring and fall. A greenhouse plant adaptable to mild-climate gardens.

***R. mucronatum* 'Sekidera'**—(See previous entry also.) In mild climates, this *R. mucronatum* cultivar produces flowers in both fall and spring.

'Snowbird'—Crisp, single white flowers and evergreen foliage. Introduced in southern California years ago.

'Twenty Grand'—Semi-double flowers, rose-pink and weather-resistant. An evergreen developed for greenhouse trade, but now an enduring favorite for outdoors.

'Ward's Ruby'—Red-flowered Kurume valued for sun-resistant flowers and foliage.

ROCKY MOUNTAIN AREA—Ted Van Veen, Portland, Oregon

Note: The area covered here is predominantly Salt Lake City and Denver.

10 Rhododendron Species

R. albiflorum—Single, creamy white flowers along the stems in July. Erect plant of medium height with deciduous foliage. Native to the high-mountain country.

R. carolinianum—Bell-shaped pink, lavender-pink, or rose flowers and small, glossy green leaves on a broad but upright plant. Ultimately 6-8 feet in height.

R. impeditum—See previous entry.

R. intricatum—Lilac flowers in tight clusters on a twiggy, low plant with small leaves. Similar to *R. impeditum*.

R. keiskei—Clusters of bell-shaped, lemon flowers in early spring. The dwarf form of this species remains a compact shrub with olive-green foliage.

R. keleticum—See previous entry.

R. minus—Medium-size trusses of lavender-rose flowers, lightly spotted, in late season. Dark green leaves, rust-colored on their undersides. Ultimately large, spreading shrub up to 10 feet or more. Heat resistant.

R. mucronulatum—Abundant rosy-pink flowers in early spring and deciduous foliage. Loose growth habit can be controlled by pruning and heavy shearing.

R. racemosum—See previous entry.

R. yakusimanum—See previous entry.

10 Rhododendron Hybrids

'America'—Red, ball-type flower trusses. Broad, bushy habit of medium height.

'Blue Diamond'—See previous entry.

'Catawbiense Album'—White flowers in rounded trusses wits long, narrow leaves. Tall, vigorous. Introduced over a century ago.

'Cynthia'—Large, conical trusses of rose-crimson flowers. Attractive, dense foliage. A large plant.

'Nova Zembla'—Red flowers. Similar to 'America,' but with a better growth habit.

'Parsons' Gloriosum'—Compact, conical trusses of lavender flowers in abundance. Compact yet tall growth habit; dense, dark green foliage.

'Purple Splendour'—See previous entry.

'Ramapo'—Small violet-blue flowers on a low, spreading plant with tiny, blue-green leaves. Very hardy and tolerant of sun or shade.

'Roseum Elegans'—Dome-shaped trusses of rose-lilac flowers.

'Trilby'—Deep crimson flowers, with darker center markings, carried in a tight, ball-shaped truss. Distinctive gray-green foliage; red stems. Compact, medium growth.

10 Azalea Selections

'Betty'—Two-inch pink flowers and evergreen foliage. Upright plant of medium height. A Kaempferi hybrid.

Exbury—Knaphill Hybrids—See previous entries.

'Fedora'—Violet-red flowers in midseason and evergreen foliage. Medium growth habit. A Kaempferi hybrid.

'Lorna'—Double pink flowers and evergreen foliage. A Gable hybrid and similar to his 'Rosebud.'

Mollis Hybrids—Flowers similar to those of the Exbury group, but usually smaller and less hardy. Deciduous foliage.

'Othello'—Brilliant red flowers, 2 inches across. Evergreen foliage. A Kaempferi hybrid.

'Purple Splendor'—The Gable hybrid with hose-in-hose purple-red, frilled flowers. Evergreen foliage. Spreading habit.

'Rosebud'—See previous entry.

R. schlippenbachii—See previous entry.

'Stewartstonian'—Blood red flowers with evergreen leaves, which take on wine-red tints in winter. A Gable hybrid.

Right: Rhododendron laetevirens (the Wilson rhododendron) and a border of candytuft (*Iberis sempervirens*) at Planting Fields Arboretum. This rhododendron is more valued for its graceful narrow leaves than its small rose-colored flowers.

Below: Azalea walk at Planting Fields Arboretum is one of the outstanding displays in the Northeast.

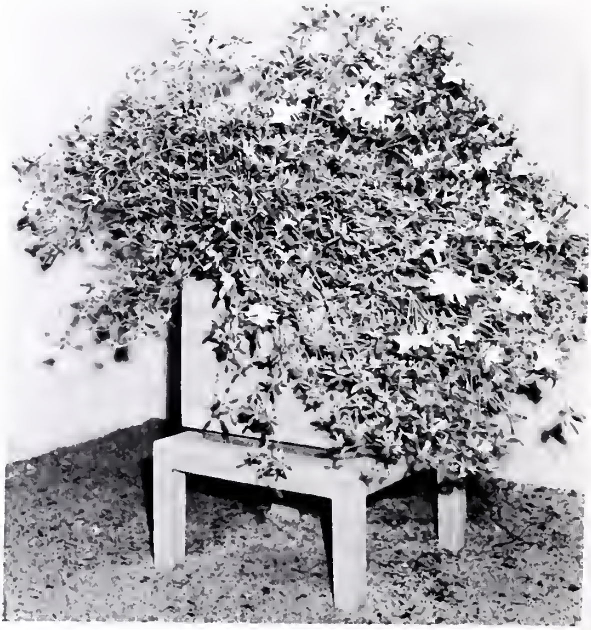
Marjorie J. Dietz

Gottscho-Schleisner

Marjorie J. Dietz (Sidney and Clara Burns Garden)

California Redwood Asso.

Above: Rhododendrons and deciduous and evergreen azaleas are combined in a long border at the edge of a woodland.
Right: Evergreen azaleas in both their hardy and not-so-hardy forms have always been popular as potted plants. Here, especially constructed for the purpose, a redwood box and stand display the weeping form of an evergreen azalea.



THE GREAT LAKES REGION—Clarence E. Lewis, East Lansing, Michigan

10 Rhododendron Species

R. carolinianum—(See previous entry also.) This species has been known to grow where winter temperatures may go 35 degrees below zero, but I suspect there was probably a deep snow cover.

R. catawbiense—Magenta to purple flowers in great profusion. A very hardy species suitable for severe winter climates. Hardy to —30 degrees F.

R. laetevirens—Not a species, but it reacts so much like one I have taken the liberty of placing it in this category. Small rose flowers in late spring and narrow leaves. Valuable for its dense, billowy growth and low stature (3-4 feet). Excellent for massing.

R. maximum—The Rosebay Rhododendron. Lavender to purple-pink flowers in early summer and long, dark green drooping leaves. The giant of American species; beautiful tree-like structure.

R. micranthum—Very tiny white flowers in clusters in June. Small leaves, not over 1¾ inches long, and a rather twiggy, upright habit. A worthy, rugged species hardy to about —25 degrees F.

R. minus—See previous entry.

R. mucronulatum—(See previous entry also.) The selection 'Cornell Pink' shows deeper red tints in its foliage in the fall as well as flowers closer to true pink.

R. racemosum—(See previous entry also.) In protected northern areas, this species has withstood very low temperatures (—15 degrees F.) where snow has been a good insulator. In East Lansing it has survived very well; our plant is only 18 inches tall after 8 years.

R. smirnowii—Pink to rose-colored flowers and dark green leaves with a feltlike coating on their undersides. Rounded, dense habit and height about 6 feet in gardens.

R. yakusimanum—See previous entry.

10 Rhododendron Hybrids

'Boule de Neige'—White flowers and handsome foliage. A slow-growing compact plant usually as high as it is wide. Blooms at a young age. A valuable plant for many landscaping uses, but it should be avoided in most foundation plantings, as eventually the plants outgrow the space.

'Mrs. Charles S. Sargent'—Rich carmine-rose flowers spotted yellow. A worthy selection for cold areas.

'Nova Zembla'—(See previous entry also.) Not only cold tolerant, but also heat resistant.

'Parsons' Gloriosum'—(See previous entry also.) Of iron-clad hardiness.

'Pinnacle'—Pure pink flowers. It has an 8-year record of hardiness in temperatures of —15 to —20 degrees F. A Shammarello introduction.

'P. J. M.'—Profuse lavender-pink flowers in early spring. Leaves turn to bronze and purple shades in the fall, remaining so all winter. As new leaves become mature, the old leaves turn red in the summer.

'Ramapo'—See previous entry.

'Roseum Elegans'—Lavender pink flowers. Reliable for its ability to flower well and suffer temperature extremes without injury.

'The General'—Rich crimson-red flowers with dark blotches in their throats. Dark green leaves. A rugged hybrid from Shammarello.

'Windbeam'—Profuse white flowers become suffused with pink. Slightly aromatic foliage. Semi-dwarf habit. A Nearing hybrid.

10 Azalea Selections

R. arborescens—Sweet Azalea. Fragrant white flowers in mid-June and glossy green leaves which become red in the fall. The swamp azalea (*R. viscosum*) has white flowers of similar fragrance in July.

R. calendulaceum—Flame Azalea. Flowers range from yellow to orange and scarlet. Remains at about 5-7 feet under cultivation. A good native azalea for northern gardens.

Gable Hybrids—Four which have been reliable in Michigan are 'James Gable,' red hose-in-hose flowers; 'Louise Gable,' semi-double pink flowers; 'Herbert,' a spreading, shiny-leaved selection with purple flowers; 'Rosebud.'

Ghent Hybrids—Three very colorful ones: 'Coccinea Speciosa,' orange flowers; 'Gloria Mundi,' orange-yellow-red coloration; 'Narcissiflora,' double yellow flowers, sweetly fragrant. These and others in this group have responded to temperature extremes—even to —20 degrees F.

Mollis Hybrids—See previous entry.

R. nudiflorum—Pinxterbloom. Light pink, long tubular flowers in late May. Hardy in extremely low (—25 degrees F.) temperatures. Grows about 6 feet under cultivation.

R. yedoense poukhanense—Korean Azalea. Violet-purple flowers liberally produced in early to mid-May; light, glossy green leaves. Especially hardy in Michigan.

Shammarello Hybrids—Several azalea hybrids. 'Hino-red' with a dense form and brilliant orange-red flowers; 'Helen Curtis,' white flowers. Hardy in the northern states.

R. schlippenbachii—(See previous entry also.) Low temperatures have provided no problems for this species.

R. vaseyi—Pink-shell Azalea. Soft pink, semi-open flowers in mid-May. Grows in a variety of soils as long as they are acid and well drained. 'White Find' is a pure white form.

NEW ENGLAND—Edmund V. Mezitt, Weston Nurseries, Hopkinton, Massachusetts

5 Rhododendron Species

R. catawbiense—(See previous entry also.) The var. *album* is considered to be a superior variant for gardens. The var. *compactum* has a low, spreading habit.

R. carolinianum—(See previous entry also.) The var. *album* has large, pure white flowers which usually appear a week later.

R. maximum—See previous entry.

R. mucronulatum—See previous entry.

R. smirnowii—See previous entry.

14 Rhododendron Hybrids

'America'—See previous entry.

'Blue Peter'—Lavender-blue flowers with a dark blotch. Not reliably hardy here except to about 20 miles in from the coast.

'Boule de Neige'—See previous entry.

'Caractacus'—Purple-red flowers. An old Catawbiense hybrid.

'Catawbiense Album'—See previous entry.

Laetevirens—See previous entry.

'Mrs. Charles S. Sargent'—See previous entry.

'Mrs. P. den Ouden'—Deep crimson flowers on a compact; densely foliaged plant.

'Nova Zembla'—See previous entry.

'P.J.M. Victor'—A superior selection from the P.J.M. group.

'Purple Gem'—Purple-violet flowers. Dwarf, compact plant with small leaves.

'Roseum Elegans'—See previous entry.

'Scintillation'—Pink flowers. Dark, glistening foliage. A Dexter hybrid.

'Weston'—Pink flowers. Compact habit. Medium growth. A Fortunei hybrid.

Azalea Selections

R. arborescens—See previous entry.

R. bakeri—(Formerly known as *R. cumberlandense.*) Bright orange-red flowers, but there can be much variation in this southern species. Blooms in early June.

'Gibraltar'—See previous entry.

Kaempferi Hybrids—Many good ones. (See also previous entries.)

Mollis Hybrids—See previous entries.

R. roseum—Rose-shell Azalea. Bright pink scented flowers. Deciduous.

Right: An especially early-blooming hybrid, rhododendron 'Christmas Cheer' has truly pink buds, then white flowers. It has a compact habit. Height: about 3 feet in 15 years.

Marjorie J. Dietz

Roche

Right: The pinxterbloom (*Rhododendron nudiflorum*) in a garden setting. It remains one of America's most popular native azaleas.

R. schlippenbachii—See previous entry.
R. vaseyi—See previous entry.
R. viscosum—See previous entry.
R. yedoense poukhanense—See previous entry.

GREATER NEW YORK—LONG ISLAND AREA—Gordon E. Jones, Planting Fields Arboretum, Oyster Bay, N.Y.

10 Rhododendron Species

R. carolinianum—(See also previous entry.) Select at flowering time for superior pink color forms free of magenta undertones.
R. degronianum—Flowers light rose-pink inside and deep pink outside in best forms. Undersides of leaves have brown-red felty hairs. A compact, rounded plant, 3-4 feet high, fully branched to base. Especially handsome.
R. discolor—Fragrant, large flowers, white to pale pink, from mid- to late June. A lovely shrub, much appreciated for its late flowers.
R. fortunei—Blush pink flowers, fragrant. Fine plant habit. Its hardiest forms should be sought from specialists in the Northeast.
R. keiskei—(See also previous entry.) Best performance here in light shade.
R. maximum—See previous entry.
R. mucronulatum—(See also previous entries.) Especially valuable in the garden when planted with forsythia, the star magnolia and daffodils.
R. racemosum—See previous entry.
R. smirnowii—See previous entry.
R. yakusimanum—See previous entry.

10 Rhododendron Hybrids

'Blue Peter'—See previous entry.
'Boule de Neige'—See previous entry.
'Catawbiense Album'—See previous entry.
'Everestianum'—Lovely frilled rosy-lilac flowers. Excellent plant habit. Reliably hardy.
'Mars'—Deep red flowers with contrasting light stamens carried in a high, compact truss.
'Nova Zembla'—See previous entry.
'Roseum Pink'—Superior form of 'Roseum Elegans' with large trusses of clear pink flowers free from lavender undertones.
'Scintillation—See previous entry.
'Wheatley'—Delicate pink flowers in outstanding high trusses. Color does not fade in open situations. Exceptional foliage and plant habit. A Dexter hybrid.
'Windbeam'—See previous entry.

10 Azalea Selections

Exbury and Knaphill Hybrids—See previous entries.
'Hinomayo'—See previous entry.
'James Gable'—See previous entry.
'Louise Gable'—(See previous entry also.) Performs best here in semi-shade.
'Martha Hitchcock'—Large 3-inch flowers, white with striking wide magenta margins. Evergreen foliage. Spreading habit. A Glenn Dale hybrid. Outstanding.
'Mary Dalton'—Hose-in-hose orange-red flowers and evergreen foliage. Tall, upright plants. A Gable hybrid.
***R. mucronatum* 'Sekidera'**—See previous entry.
'Rosebud'—See previous entry.
'Rose Greeley'—The finest early white azalea. White, 2½-inch flowers with a chartreuse blotch. Plant habit is low, dense and spreading. A Gable hybrid.
R. schlippenbachii—See previous entry.

THE GREATER PHILADELPHIA REGION—John C. Wister, Swarthmore, Pennsylvania

10 Rhododendron Species

R. *adenopodum*—Deep pink buds, flowers fading to white. Leaves have woolly undersurfaces. Blooms about the same time as *R. carolinianum*. Spreading, dense growth to about 6 feet.

R. *carolinianum*—See previous entry.

R. *catawbiense*—See previous entry.

R. *fortunei*—(See previous entry also.) One of the faster growing of the large species.

R. *keiskei*—See previous entry.

R. *maximum*—See previous entry.

R. *mucronulatum*—See previous entry.

R. *racemosum*—See previous entry.

R. *vernicosum*—Variable species with light pink flowers, sometimes caught by frost here. A large, spreading shrub to about 8 feet.

R. *yakusimanum*—See previous entry.

10 Rhododendron Hybrids

'Boule de Neige'—See previous entry.

'Catawbiense Album'—(See also previous entry.) This white hybrid was raised by Waterer before 1850. The unfortunate name causes confusion with the white variety of the native *R. catawbiense*.

'Dora Amateis'—White flowers in abundance. Compact habit.

'English Roseum'—Clear pink-flowered form superior to the popular 'Roseum Elegans.'

'Mary Fleming'—Yellowish tinged salmon flowers in numerous tight clusters. A Nearing hybrid.

'Montchanin'—Small white flowers in abundance. Height 4-5 feet.

'Nova Zembla'—See previous entry.

'Purpureum Grandiflorum'—Purple flowers—recommended for those who like purple!

'Scintillation'—See previous entry.

'Windbeam'—See previous entry.

10 Azalea Selections

'Annamaria'—White flowers on a tall plant. Evergreen foliage. A Kaempferi hybrid.

R. *calendulaceum*—See previous entry.

'Daviesi'—Fragrant white flowers touched with yellow. Deciduous foliage. A Ghent hybrid.

'Hollandia'—Double orange-yellow flowers. A Ghent hybrid.

'James Gable'—See previous entry.

'Louise'—Pink flowers and evergreen foliage. Tall plant. A Kaempferi hybrid.

R. *roseum*—See previous entry.

'Rose Greeley'—See previous entry.

R. *schlippenbachii*—See previous entry.

R. *vaseyi*—(See also previous entry.) Rather straggly plant habit, but foliage colors handsomely in fall.

MIDDLE ATLANTIC REGION—Thomas Wheeldon, M.D., Gladsgay Gardens, Richmond, Virginia

10 Rhododendron Species

R. *carolinianum*—See previous entry.

R. *catawbiense*—See previous entry.

R. *decorum*—Loose clusters of white to deep pink flowers with yellow throats. Very fragrant. Large plants which gradually become tree-like.

R. *discolor*—See previous entry.

R. *fortunei*—See previous entry.

R. keiskei—See previous entry.
R. maximum—See previous entry.
R. mucronulatum—See previous entry.
R. racemosum—See previous entry.
R. yakusimanum—See previous entry.

10 Rhododendron Hybrids

'Anah Kruschke'—See previous entry.
'Beaufort'—Fragrant white flowers. ('Boude de Neige' x *fortunei.*) A Gable introduction.
'Catawbiense Album'—See previous entries.
'Chionoides'—White flowers on a low, compact plant. Medium-size foliage. Useful landscaping plant for today's small gardens.
'Goldsworth Yellow'—Apricot buds become yellow flowers—dotted with bronze on upper lobes. Blooms in late May.
'Graf Zeppelin'—Bright pink flowers and large, dark leaves. Vigorous.
'Jean Marie de Montague'—See previous entry.
'Rocket'—Deep coral-pink flowers and thick leaves on a sturdy, upright plant. Resistant to heat and sun. A Shamarello hybrid.
'Scintillation'—See previous entry.
'Vulcan'—Brick-red flowers and dark green pointed leaves. An attractive compact plant.

10 Azalea Selections

R. calendulaceum—See previous entry.
'Dawn'—Violet-mauve hose-in-hose flowers and evergreen foliage. A spreading, dense plant of medium height. A Pericat hybrid.
'Dayspring'—Pink flowers on a large spreading plant. One of the loveliest of the Glenn Dale hybrids.
'Delos'—Pink flowers. A Glenn Dale hybrid.
'Gibraltar'—See previous entry.
'Helen Close'—Flowers white with a pale yellow blotch. Spreading plant of medium height. A Glenn Dale hybrid.
'Rosebud'—See previous entry.
'Saggitarius'—Pink flowers with a salmon understone. Spreading, low plant. Flowers very late. A Glenn Dale hybrid.
'Tama-sugatu'—Large single flowers, white with orange-red margin. Late flowering and variable. A Satsuki hybrid.

THE SOUTHEAST—Fred C. Galle, Callaway Gardens, Pine Mountain, Georgia

5 Rhododendron Species

R. chapmannii—Funnel-shaped pale pink to rose flowers in a mounded truss. Native to the coastal plain of northwest Florida. Somewhat similar to *R. carolinianum* in appearance.
R. fortunei—See previous entry.
R. maximum—See previous entry.
R. minus—See previous entry.
R. ovatum—Open, rather flat-shaped white to pink or mauve flowers, about 1 inch across. The leaves are egg-shaped. A species from eastern China, which does well in the south but may be hardy to New York City.

13 Rhododendron Hybrids

'Alice'—Pink flowers which fade to rose. Foliage is sun-tolerant, but flowers should receive some shade.
'Anne Rose Whitney'—Pink flowers and large leaves. Tall plant which needs space.
'Album Elegans'—White flowers tinged lilac. A tall plant.
'Amy'—Rose-pink flowers. Sun and heat tolerant.

'America'—See previous entry.
'Blue Peter'—See previous entry.
'Cynthia'—Rose-colored flowers. Retains compact form when exposed to some sunshine.
'Jan Dekens'—Ruffled pink flowers in a tight truss held upright. Large glossy leaves. A tall plant.
'Jean Marie de Montague'—See previous entry.
'Roseum Elegans'—See previous entry.
'Scintillation'—See previous entry.
'Vulcan'—See previous entry.
'Windbeam'—See previous entry.

11 Azalea Selections

R. alabamense—White to pink flowers, fragrant. Deciduous foliage. Native to Alabama.
R. austrinum—Yellow to orange flowers. Native to Florida and the Georgia-Alabama coastal plain.
Back Acre Hybrids—Mid- to late flowering types, gaining in popularity.
R. bakeri—See previous entry.
'Balsaminaeflora'—Very late double coral flowers on a creeping plant.
R. calendulaceum—See previous entry.
R. canescens—White to pink or rose flowers. Fragrant. A widely distributed southern azalea.
Glenn Dale Hybrids—Favorites here include 'Allure'; 'Beacon'; 'Evensong'; 'Festive'; 'Copperman'; 'Greeting'; 'Glacier'; 'Martha Hitchcock'; 'Refrain'; 'Treasure.'
Kurume Hybrids—'Bridesmaid'; 'Christmas Cheer'; 'Pink Pearl'; 'Snow'; and many others. (See also previous entries.)
Southern Indian Azaleas—'Pride of Mobile'; 'George L. Tabor'; 'Formosa'; 'Fielder's White'; and many others.
Satsuki Hybrids—'Gunbi'; 'Gunrei'; 'White Gumpo'; 'Pink Gumpo' and others.

Often described as resembling an evergreen spirea, *Rhododendron micranthum* is useful for a change in texture in ericaceous plantings because of its twiggy appearance. It is fine when grown among heathers.

The plumleaf azalea *(Rhododendron prunifolium)* bears flowers in the apricot to orange-red and red range, and is valued for its late flowering—in July and August.

Throughout the South and elsewhere, "bush-honeysuckle" is often the name for

AMERICA'S NATIVE AZALEAS

Henry T. Skinner

IN the far-off days of America's settlement and exploration, her shrubs and wild flowers were eagerly sought by the courts and nobility of Europe. Among these treasures there were few items more greatly prized than the occasional specimen of our eastern azaleas. The first to reach England from Virginia was the white swamp azalea, *Rhododendron viscosum,* which, in 1680, took second place, only, to the tulip tree as an attraction of Fulham Palace, residence of the colorful Bishop Compton who happened then to be in disfavor with the Papist Court of King James II. Identifications were nebulous in those days, and the new plant was named or described by the Bishop's botanical friend Plukenet as *"Cistus virginiana flore et odore periclymeni"*—"the Cistus from Virginia with flowers and fragrance of the honeysuckle." *Cistus* proved later to be a rather wild guess, but the popular name of "swamp-honeysuckle" has stuck even though the plants are not at all related to true honeysuckles. All wild azaleas have remained "bush-honeysuckles" to the countryfolk of our southern states.

The pinxterbloom, *R. nudiflorum,* arrived just a little later, sent by John Bartram, King George the Second's Botanist-in-America, to the ardent English collector, Peter Collinson. "Pinxter" derives from the use of this azalea's pink blossoms in the Pinckster Frolics marking the Feast of Pentecost in New York, which was then Niew Amsterdam. It is scarcely surprising that the flame azalea, *R. calendulaceum,* was the next passenger to Europe, for this, the "Sky Paint Flower" of the Cherokees, had been named the fiery azalea by William, the son of John Bartram, and glowingly described by him as "certainly the most gay and brilliant shrub yet known." The introduction, this time, was to Belgium and France instead of England. The plants and seeds were carried by the French botanist, André Michaux, were rescued from shipwreck, and were apparently spared through the personal intercession of the Empress Josephine when her husband, Napoleon, threatened destruction of the botanic garden in Ghent in 1802. Other species followed soon after, but these three, together with the yellow azalea of the Caucasus, *R. luteum,* provided the principal ingredients for the supreme confection of

Iortier, a garden-minded baker of hent, Belgium — the confection, of ourse, being the Ghent hybrid azaleas. ther crosses were made and along with he Ghent azaleas, formed the basis of the naphill hybrids. From these, in turn, ame Lionel de Rothschild's magnificent xbury hybrids of current use. To such egree have America's wild azaleas been rized by the gardeners of other lands.

In matter of distribution, these native zaleas come from the woods and stream-ides of some 27 of our eastern states, rom upper New York to Florida, Texas, nd the Midwest, with one outlier, the estern azalea, in southern Oregon and alifornia. They comprise a present-day isting of 17 species in a flower color ange of strong red to orange, yellow, lear pink, lavender, and purest white. hese colors are often found in varied ombinations within the same flower, in ifferent flowers of the same bush, or mong different individuals of the same pecies. Each species, moreover, as with ll plants, comprises a wide range of ndividuals which are always different rom one another, with respect to a vari-ty of characters besides that of flower olor. The species, in other words, is ariable and, of course, there is still reater variation from one species to nother. While in the flame azalea the verage (and perhaps most easily ob-ained) representative is likely to be of enuine garden merit, in other kinds, uch as the swamp-honeysuckle, the aver-ge plant may be poor to nondescript rom the display standpoint. The solution ies, of course, in the process of selection. he best representatives of the better pecies could be ranked excellent, while ven in the less exciting species the better elections can be very good. One can find ood forms in the wild but, unfortunate-y, it is not easy as yet to obtain the best rom commercial sources. They are being rown, however, and they are also being ropagated.

In reviewing characteristics of the everal species, there seems merit in rouping them by color, since flower color ften, though not always, implies a degree of botanical kinship, so let us start with the reds, red-oranges, and yellows.

Photographs from National Arboretum

A yellow hybrid of the sweet azalea (*R. arborescens*) which blooms in July.

At the top of this list, the whole list, we have no hesitation in placing the flame azalea, *R. calendulaceum,* of the lower elevations of the southern Appalachian mountains. In hardiness and for its splendid show of large, clear yellow to orange, red or pastel-shaded flowers, borne on bushes up to 10 feet or more in height, the flame azalea has few, if any, peers. A maturing specimen in full flower has a grace that no Knaphill or Exbury hybrid can probably ever equal. Though taxonomically unseparated, the flame azalea actually appears to comprise two forms: A large-flowered, lower elevation population which flowers in mid-May, and one with slightly smaller flowers which blooms at higher elevations in early to mid-June. The second variety provides the splendid display at Soco Gap and along other stretches of the southern end of the Blue Ridge Parkway from Soco to Great Pisgah Mountain. Both forms of *R. calendulaceum* are tetraploid with 52 chromosomes, suggesting that this may be a species of comparatively recent evolutionary origin. *R. canadense* is also a tetraploid. All other species are diploid, with 26 chromosomes.

Closely allied to the flame azalea, and

The Cumberland azalea *(R. bakeri)* surrounded by a dwarf willow on Gregor
Bald, North Carolina. Its flowers are similar to those of the flame azalea.

quite probably a parental type, is the smaller-flowered and lower-growing Cumberland azalea, *R. bakeri,* a plant of the Cumberland Plateau from Kentucky, south to Georgia. Its colors are very similar except for a stronger tendency towards red. It is proving especially useful for garden decoration and for breeding purposes by virtue of its delayed flowering in mid-to-late June. Still later flowering in July and August, and unique from both decorative and breeding standpoints, is the plumleaf azalea, *R. prunifolium,* with its similar color range of apricot to orange-red and red. This species eventually forms a large, round-topped bush, with abundant flowers held more or less vertically above fresh green foliage. Most clones are decorative, and cuttings root more readily than those of any other orange-to-red azalea. But the plumleaf hails from a relatively small section of southern Georgia and Alabama and may not be hardy much north of New York.

The two remaining, in the red-yellow orbit, are the red Oconee azalea, *R. speciosum,* and the pale to deep yellow Florida azalea, *R. austrinum.* The first has particularly good color, while the second is especially vigorous and roots well from cuttings. In hardiness, they are comparable to plumleaf azalea, but both are stil scarce in nurseries.

Allied to the flame azalea, though yel low only in its blotch, is the beautiful predominately pinkish western azalea, R *occidentale.* Deliciously scented and contributor to the finest of the garde hybrids, this western azalea unfortunatel has proved useless in eastern gardens Like the western dogwood, it simply wil not grow unless grafted, perchance, to th roots of an eastern species.

Turning next to the pinks, we mus accord first place to the pinkshell, R *vaseyi,* from a mountain habitat in south western North Carolina. Botanically dis tinctive in its alliance with the littl lavender-flowered rhodora, *R. canadense* of the northern bogs, and as an exquisite ly modeled miniature of the Japanes royal azalea, I would rank pinkshell nex to flame azalea for garden value. It i early blossoming and is variable in inten sity of pink. When a choice exists, th deeper shades are generally to be pre ferred—with exception of an excellen clear white cultivar which has been calle 'White Find.' It grows to 6 or 8 feet tall The foliage is clear and turns bronzy re before falling.

Differing in its grayer foliage and i its pointed petals, widespread at th ase, but almost equally good, is the amed rose-shell azalea, *R. roseum*, of the nountain tops of the Shenandoah. This ovely clove-scented azalea actually folows the hill tops all the way into southrn Quebec and is extremely hardy. Its larker color forms, again, are the more ttractive. Its one major fault lies in its eluctance to be propagated by cuttings.

The two remaining pinks may well be he best known of all "bush-oneysuckles," for between them they righten the woods and hedgerows over normous stretches of countryside. *R. udiflorum,* the pinxterbloom, may be ound from South Carolina to Tennessee, Vest Virginia, and New England. Its outhern counterpart, *R. canescens*, the Florida pinxter, or hoary azalea, extends rom a South Carolina overlap area to Florida, Texas, Arkansas, and the southrn parts of Tennessee and North Carolia. Both are very variable and both have color range from the occasional pure vhite through all shades of pink to plum ed and purple. Grown in moderate sunight, the best selections are freelowering and highly decorative despite he fact that more ordinary forms can be nexciting to quite poor. Florida pinxter nay attain heights of 15 or more feet and n flower and habit is somewhat the more raceful, but it also is more tender. Its ardiest representatives will come from he more northerly part of its range and hould succeed in southern New England. They will flower in early to mid-May.

Within the third color group, we have a hoice of six white-flowered species vhich, together, are capable of providing n almost continuous display sequence rom April to September or later. All six, nowever, are not of equal garden merit. As companion to the best of the reds and inks, my own first preference, as of this vriting, would be for the elegant, lowrowing, gray-leaved and deliciously cented coast azalea, *R. atlanticum*. Its lossoms are of good size, and nicely orne. Fall foliage can turn a lovely olor; the plant tends to be vigorously toloniferous and also can be readily muliplied by cuttings. A close runner-up to

Flowers of the Florida azalea, *R. austrinum*: yellow with red-tinted tube.

The white flowers of the coast azalea (*R. atlanticum*) often have a pink tube.

the foregoing, and one which flowers at about the same time in early May, is the Alabama azalea, *R. alabamense.* Little grown and seemingly little known, this is a true beauty. Of purest white, its flowers are yellow blotched and distinctively lemon scented. Though basically low-growing (to 2 or 3 feet only) and somewhat small-flowered, the Alabama azalea has been induced by environment and the insects to produce a taller and much showier *canescens*-influenced phase with big, round, pincushion flower balls. As luck has it, this is the form most readily available from commercial sources.

A third good white, July-flowering and of ironclad hardiness, is the sweet azalea, *R. arborescens,* of the mountain streamsides of central Georgia to Pennsylvania and New York. Even the average plant of this species has a plentiful supply of reasonably large flowers so long as the soil is moist and overhead shade is not too dense. The foliage, sometimes gray beneath, is glossy, clean and attractive. The bush tends to be upright and fairly tall, and fall color can be striking.

Swamp-honeysuckle, *R. viscosum,* the azalea of such early export, is typically a stoloniferous, green- (rather than gray-) leaved plant of wet soils of the Coastal Plain and lower Piedmont from the Carolinas to New England. Blossoming is in late June and early July but, with exception of occasional individuals, and in comparison with the sweet azalea, the flowers tend to be small and less than exciting. Nevertheless, they are strongly

An 8-foot high plant of the vigorous Florida azalea *(R. austrinum)* in the National Arboretum, Washington, D.C. Its flowers are yellow. This species, unlike some deciduous azaleas, roots well from cuttings, so superior forms can be perpetuated.

An Arkansas variation of the Florida pinxter, *R. canescens,* with near-white flowers marked by a cherry-red tube. Usual color range is pink to plum-red.

and sweetly scented and may well make up in quantity for what they too often lack in individual quality. While the swamp azalea contributed fragrance, hardiness, vigor, and heat tolerance to the Ghent hybrids, its influence upon flower size was unquestionably negative.

The last two whites are of minor significance for the northern gardener. The Texas azalea, *R. oblongifolium,* offers no improvement over *R. viscosum* and is less hardy. The hammocksweet, *R. serrulatum,* is the "*viscosum*" of the Gulf Coast, within a shoreline band extending from central Florida to Louisiana and, probably, Texas. It is only variably hardy in the north. Its prime merit is lateness of bloom, and we are using it at the National Arboretum to produce hybrids for August and September effect. Hammocksweet has an attractive rounded growth habit and carries good foliage both in summer and autumn, but its white to creamy flowers are unfortunately quite small.

These are the 17 species. All are variable and some have been subdivided into a number of botanical varieties such as the dwarf, mountain-top version of the swamp azalea, *R. viscosum* var. *montanum,* or the curious little white azalea of central Georgia and Alabama, which is usually listed as *R. viscocum* var. *aemulans.* Exclusive of the species, however, a number of natural hybrids are worthy of consideration, for natural hybrids do occur, quite frequently, when the separate species of this enormous azalea population happen to meet. A series of these hybrids are being grown by fanciers in various parts of the country and some of the best will doubtless find their way into general cultivation.

Perhaps the brightest aspect of this reawakened interest in America's wild azaleas centers around their increasing reuse in breeding projects focusing upon new objectives. The loveliest hybrid from the hand of a Van Houtte, a Koster, or a de Rothschild may amount to little in the gardens of Washington, D.C., Philadelphia, or New York. The cool climate of Western Europe is not the climate of our eastern seaboard, and there is more to a successful plant than flower size and color. Our natives were born to winter cold and to summer heat. Through the recombining of the best of our wild species with the best performers of Europe's hybrids can be evolved new races of garden azaleas equal to the finest from overseas, with attractive habit, with flowers of good quality, and the ability to perform with minimal care. ◆

Rare species from New Guinea for the greenhouse . . .

RHODODENDRONS FROM MALAYSIA

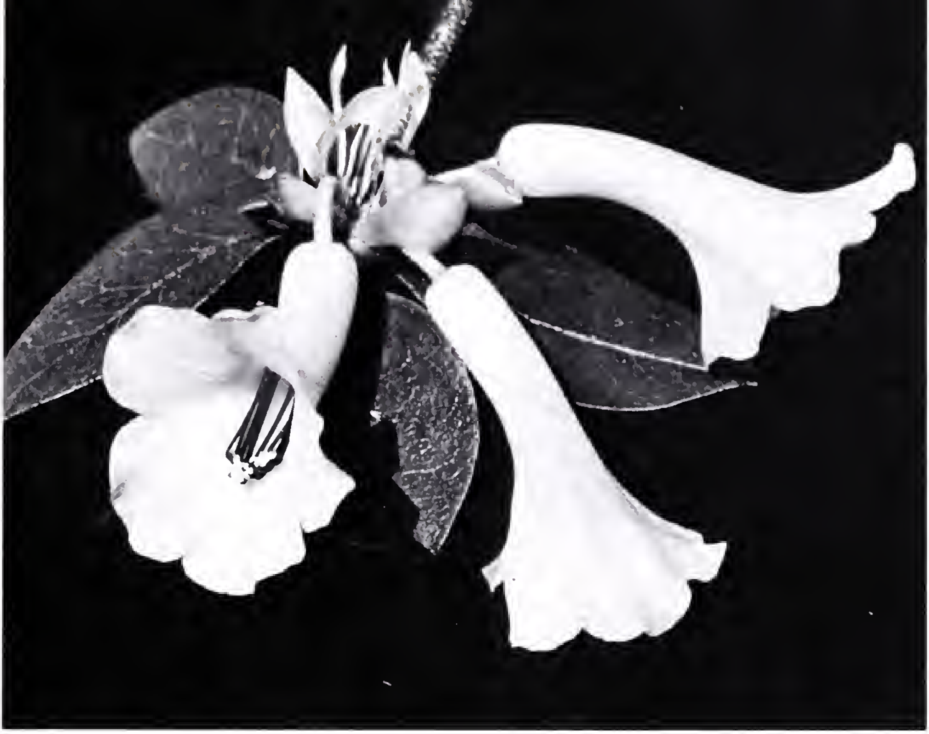
P. H. Brydon

ALTHOUGH rhododendrons have been in cultivation for over 150 years, few gardeners have had the experience of growing species or hybrids of Malaysian origin. This is understandable since in recent years plants have not been available and, even if they had, they would require greenhouse protection in most parts of the United States. With the great increase in rhododendron hybridization, the potential of these Malaysian species should provide a source of desirable characters to include in hardier garden varieties. Quite apart from their use as parents for new varieties, the Malaysians are a fascinating group for those who have greenhouse space. They can prolong the season of interest in the genus with flowers in summer, fall, and winter.

The considerable excitement caused by these species and hybrids has been brought into focus by Dr. H. Sleumer's book, *An Account of Rhododendron in Malesia* (P. Noordhoff, Ltd., Groningen, The Netherlands). Dr. Sleumer states that over one-third of the known rhododendron species occur in that area of the S.W. Pacific which stretches eastwards from the Malay Peninsula encompassing Sumatra, Java, Borneo, Celebes, New Guinea, the Philippines, various smaller islands and the northern tip of Australia.

In 1843, the English nursery firm of Messrs. Veitch sent Thomas Lobb to collect ornamental plants in Malaya, Java, and Borneo. Among the species collected by Lobb were *R. javanicum*, *R. brookeanum*, *R. jasminiflorum* and others from which Veitch created over 200 hybrids. Because of their geographical origin, these were called "Javanicum" hybrids. The flowers showed brilliant shades of orange, yellow, red, and pink but strangely enough, no blues and, as Dr. Sleumer observes, there do not seem to be blue shades among species native to the Malaysian area. The records show that in 1897 Veitch exhibited "Javanicum" hybrids in flower at the Royal Horticultural Society's shows in London every month of the year. The displays revealed an important character of Malaysian rhododendrons which may be put to good advantage in the production of hybrids that will flower throughout the year under the proper conditions. This is explained by the fact that the species are found within altitudes of 20 degrees N. and 20 degrees S., where daylight almost equals that of darkness and where there is little variation in seasonal temperatures. It has been observed that plants under cultivation grow, produce flowers, and grow again to produce more flowers the same year. In their wild state, there is not the definite resting period that is found in plants from a more northerly latitude. Many of the species are epiphytic as well as terrestrial, and Veitch discovered that if plants were cultivated in open beds under glass, they flowered sparingly and vegetative growth was excessive. When they were grown in pots with root growth restricted, flower buds appeared in greater abundance.

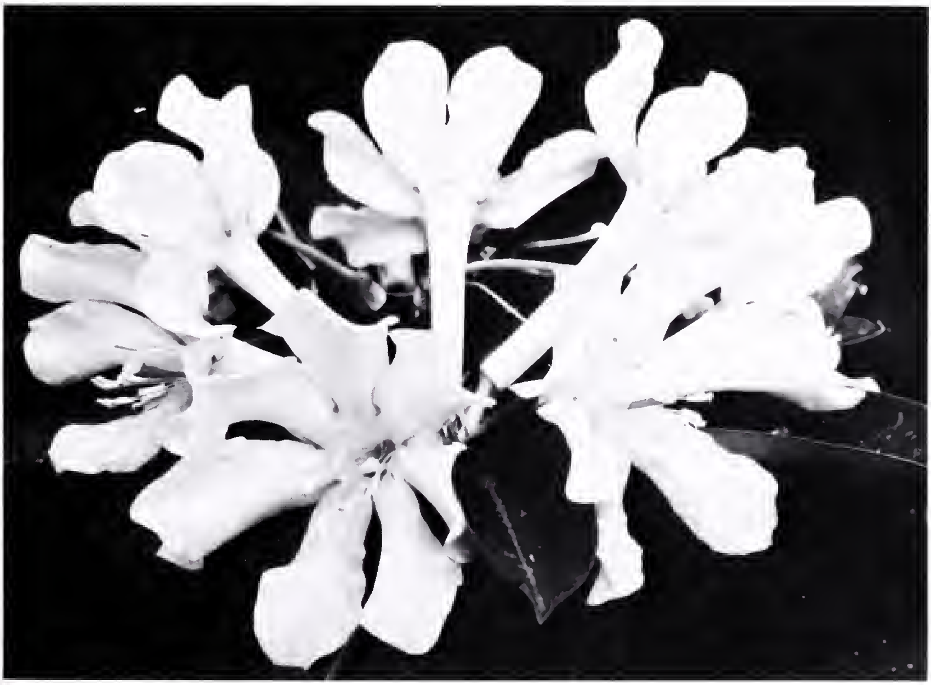
The species and hybrids became popular in the late 19th and early 20th centuries with gardeners of sufficient affluence to afford a large conservatory wherein the plants could be displayed. It is surmised that with the changing economy in Great Britain during World War I, the large estate owners were unable to



Dr. J. Evans

Two rhododendrons from New Guinea: *(above) R. leptanthum; (below) R. leucogigas.*

P. H. Brydon



The flowers of *R. culminicolum* var. *angiense* are reddish pink and 2 inches in length.

keep up the costly glasshouses and many of the "Javanicum Hybrids" were lost to cultivation. However, it is also possible that the tremendous and exciting influence of new species from S. W. China and the Himalaya brought back by collectors Wilson, Forrest, Kingdon-Ward, Farrer, and Rock turned rhododendron enthusiasts away from the tender varieties to the hardier relatives which proved so amenable to the British climate.

In 1961, the California Chapter of the American Rhododendron Society participated in sponsoring Dr. Sleumer's expedition to Malaysia. Seeds and cuttings were sent back to the Strybing Arboretum in San Francisco where they were grown on and eventually disseminated to members of the California Chapter. From these, various amateur breeders are busy creating new forms, some of which have flowered and show great promise for climates comparable to San Francisco and, of course, for those who live in less equable climates but do have the advantage of a glasshouse.

One of the remarkable features of the flower colors, ranging from orange to pastels and bright reds, in many species is that the color tends to intensify with age rather than fade, as is the case in many of our garden hybrids. Fragrance is much sought after by breeders and this is a noticeable feature of many of the Malaysians. The floral shapes are often unusual. For example, in *R. wrightianum* var. *cyclopense,* the flowers are reminiscent of a large *Abelia floribunda* and in *R. culminicolum* var. *angiense,* the corollas are oblique and resemble a large salvia flower. The flower substance is often heavy and fleshy with great staying power, particularly in hot weather. Arthur Headlam of Australia states in a letter that *R. laetum,* a golden yellow species from New Guinea, flowered for him in mid-January when the temperatures ranged from 105, 94, and 110 deg. F. Yet, when the flowers dropped in mid-February, they were still fresh and the color had intensified! Their ability to flower more than once a year has been mentioned and it is possible that this character may play an important part in the production of plants capable of flowering anytime during the year.

To my knowledge, there are no hybrids which have flowered in existence today between species or hybrids of the Malaysian group and others in the genus. However, in 1885, a hybrid by the name of R. 'Pearl' received a First Class Certificate in London and was reported to be the result of a cross between R. 'Princess Royal' (a hybrid between *R. jasminiflorum* and *R. javanicum*), and *R. griffithianum.* Another cross is recorded between R. 'Duchess of Teck' (*R. griffithianum* hybrid) with *R. javanicum,* made by Harry Noble of England and called R.

'Lord Wolseley.' Neither of these are in cultivation today.

There is a member of the Vireya Section of the Malaysian species which occurs in Formosa called *R. kawakamii.* Michael Black of Grasmere, England, an authority on Malaysian rhododendrons, suggests that this species may prove to be a suitable parent for a hardier race of Malaysian hybrids. *R. kawakamii* occurs at an altitude of 7,000 feet and from our limited experience with its cultivation on the Pacific Coast, it seems to be hardy to at least 10 degrees F. Hadley Osborn notes that *R. kawakamii* occurs in company with *R. morii,* a species considered hardy to zero.

There is one other species belonging in the Vireya Section and which occurs on the Chinese mainland. It is *R. vaccinoides,* a native to Sikkim and S. E. Tibet at from 6,000 to 12,000 feet altitude. It is a shrub to 5 feet with bell-shaped pinkish flowers singly or in pairs. There are no reported hybrids with this species to date.

Propagation of the Malaysian species is much the same as for other members of the genus. The seed is short-lived and should be sown immediately on screened sphagnum moss, in flats or pots, enclosed within a polyethylene covered frame where the temperature range should be between 70 and 75 degrees F. Germination may take from twenty days to forty-five days. As a rule, growth after germination is much slower than in the hardier species. Hadley Osborn has been successful in speeding growth by decapitating the seedlings at ground level after the true leaves have been formed and when the seedlings are about ½ to ¾ inch high. All but the two top leaves are removed from the cutting which is then inserted in screened moss and the resulting plant frequently outgrows the seedlings by a considerable margin. As soon as the seedlings, or rooted-seedling cuttings, are large enough to handle, they should be transplanted into flats or pans of equal parts of screened sphagnum moss, moist peat, and washed sand. It may be necessary to reflat the seedlings twice in the same year, before moving them on to pots. For glasshouse cultivation, a minimum night temperature of 45 degrees F. would be best although many of the species in this article have survived to 27 degrees F. out-of-doors in San Francisco.

Photographs by P. H. Brydon

***R. wrightianum* var. *cyclopense,* from Mt. Cyclops in New Guinea, has red flowers.**

But *just survival* is not enough if you want your plants to look well, hence the suggested warmer temperature. Because of their epiphytic nature, a coarse well-drained soil mixture is advised, such as 40 per cent screened leafmold, 40 percent redwood bark chips, and 20 per cent sandy loam. Do not over-pot and as long as the plants hold their foliage and make a normal growth, do not move them into larger containers; otherwise, flowering may be delayed. Many of the species and hybrids in this group tend to be leggy and awkward in pots. If a free-standing well-formed plant is desired, training should commence when the young plants are a few inches high by "pinching out" the apical bud just as it begins to elongate. Lateral branches will be induced to appear from lower down and in the event that two or only one should appear, then pinch again until an evenly spaced framework is produced. Most of the Malaysian species and hybrids will respond to small quantities of liquid fertilizers, such as fish emulsion applied during the spring and early summer months. Increasing the day length by means of

Dr. J. Evans

An exceptionally robust form of *R. macgregoriae* with orange-yellow flowers which are tinged pink.

artificial lights during the short days of winter will assist in the production of flowering wood. Frequent syringing with water is beneficial in insect and pest control and provides the moist conditions these plants enjoy.

From my observations on the more than fifty species now being grown at the Strybing Arboretum in San Francisco, I have selected the following ten which have done reasonably well. When they become available, they should provide an interesting and attractive collection for under glass in colder climates than is found in the San Francisco region.

R. christianae: S. E. New Guinea; 2,000-4,500 ft. alt. Shrub to 9 ft. Flowers 3" long, 2" wide in clusters of 3-4, deep yellow, also variable shades of salmon, orange, etc. Withstands heat.

R. konori: New Guinea; alt., 5,000-7,000 ft. Shrub to 12 ft. Flowers, large, 5 inches long 4 inches wide, in clusters of 3-8, white; strong carnation fragrance.

R. laetum: New Guinea; alt. 4,500-5,000 ft. Shrub to 6 ft. Flowers 3 inches long, 2 inches wide in clusters 6-8, deep yellow. Withstands heat.

R. leucogigas: New Guinea; alt. 4,500-5,000 ft. Shrub to 6 ft. Flowers very large, 5½ inches long and 5 inches wide in clusters of 5-8, white, edged carmine on lobes, strongly scented. A spectacular new species discovered by Dr. Sleumer.

R. lochae: Queensland; Australia; alt. 3,500-4,000 ft. Shrub to 6 ft. Flowers 2 inches long and 1½ inches wide in clusters of 2-7, rich scarlet. The only species in Australia.

R. macgregoriae: New Guinea; alt. 1,000-9,000 ft. Shrub to 15 ft. Flowers about 1 inch long in clusters of 15, color variable from pale yellow to orange flushed pink. Most common species in New Guinea.

R. retusum: Sumatra, Java; alt. 5,000-10,000 ft. Shrub 1 to 10 ft. Flowers in clusters of 4-10, tubular, scarlet. A neat little species.

R. culminicolum var. angiense: New Guinea; alt. 3,500-7,000 ft. Shrub to 15 ft. Flowers oblique, tubular, 2 inches long in clusters 4-6, reddish pink.

R. wrightianum var. cyclopense: New Guinea; alt. 4,000-5,000 ft. Shrub to 3 ft. Flowers 2-3 inches long in pendulous trusses, glossy red.

R. zoelleri: New Guinea; alt. 6,000 ft. Shrub to 18 ft. Flowers 3 inches long and 3 inches wide, in clusters of 5-8, shades of yellow, orange and salmon, sweetly scented. One of the best ornamental species.

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PROPAGATION OF RHODODENDRONS AND AZALEAS

The propagation of rhododendrons by the amateur is more of an art than a science!

Sidney Burns

WHEN the professional grows large quantities of a variety, he studies the needs of that variety to insure that his percentage of success will be high enough to justify the costs. The amateur is not concerned with his costs in time and labor as long as he has reasonable success. Different species and clones of hybrid rhododendrons respond to different treatments for best results. The time the seed is collected and planted, or the time a cutting is taken, can make the difference in success or failure. Other factors are the kind of growing season the plant went through the previous year: how cold the winter, how hot the summer, and the amount of rainfall. After a little experience a feeling for doing the right thing at the right time develops.

Growing Seed—The best seed is that you collect from your own plants. The second best is seed from a friend. Old seed, or seed of unknown parentage is rarely worth the trouble of growing. If you have not made a hand-pollinated, controlled cross, the only seed you should grow is from such species as *R. carolinianum*, *keiskei*, *racemosum* and others which do not normally cross in the open. The Exbury and Knaphill azalea seed will also usually yield good seedlings.

Seed pods should be collected in the fall after they turn brown, but of course before they burst open. The pods are left in paper envelopes in a warm place until the pods open. Do not leave in closed jars or plastic bags as the seed may mold. Seed can be started in the house during the winter or outdoors in spring. Sow in pots, flats, or any suitable container with drainage holes. The starting medium may be either milled sphagnum moss or oak leafmold sifted through a quarter-inch mesh sieve. After making sure the medium is thoroughly moist, sow the seed thinly on top. Do not cover the seed, merely press on the surface with the edge of a plant label. From now on the seeds must not be allowed to dry out for even a short time or they will die. Water may be added by misting with a fine spray so as not to wash the seed away, or the containers may be immersed in a pot of water deep enough to allow the water to be drawn up to the surface. When the seedlings have developed their second set of leaves, they may be transplanted to flats. Space plants 1 to 2 inches apart and the following year transplant into lath frames.

Rooting Cuttings—Almost any evergreen rhododendron or azalea can be rooted from cuttings. The one important rule is that the cuttings be kept in a turgid condition until rooted. Anything else you do is secondary. The use of heat and/or hormones will aid the cuttings to root faster and heavier, but unless the cuttings are kept turgid, they will not root at all.

If the cuttings are taken during summer (azaleas may be taken after mid-July, rhododendrons in August), they may be rooted outdoors under mist, (See also page 00). Set up a frame where the cuttings will receive maximum light but no direct sunlight. The rooting medium of sand and peat moss should have enough sand to provide good drainage so that air can get to the root area at all times. Mist nozzles with an automatic control are then arranged to provide sufficient moisture to keep the leaves from drying out. It is not necessary to mist during the night.

The Nearing Frame

Cuttings taken in late summer and fall may be rooted in the "Nearing" frame, a unit which requires little or no attention once it is set up. The Nearing frame consists of a cold frame constructed as shown on page 43. The open end must face directly north. The frame may be covered with glass or polyethylene. The roof and ends may be made of an opaque or translucent material but must not allow any direct sunlight to reach the cuttings. The inside of the roof should be of light enough color to reflect the north light down on the leaves of the cuttings. This frame may be modified to any suitable size.

After constructing the frame, the inside should be excavated to a depth of about 6 to 8 inches. Place about 3 inches of peat moss in the bottom, then about 3 inches of a mixture of half sand and half peat moss, followed with a thin layer of sand on top. Water the medium thoroughly before inserting the cuttings.

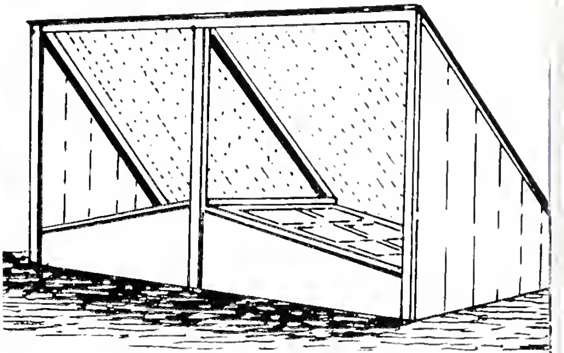
Probably the simplest method to follow in rooting cuttings is to take a seed flat, add a frame or support of three wires, and after watering and inserting cuttings, enclose the whole flat in a large polyethlene bag or "tent", and place in a well lighted area. This system may be used outdoors in summer or indoors under artificial light in winter. Again, direct sunlight must not be allowed to hit the cuttings as the temperature will rise so high as to bake them.

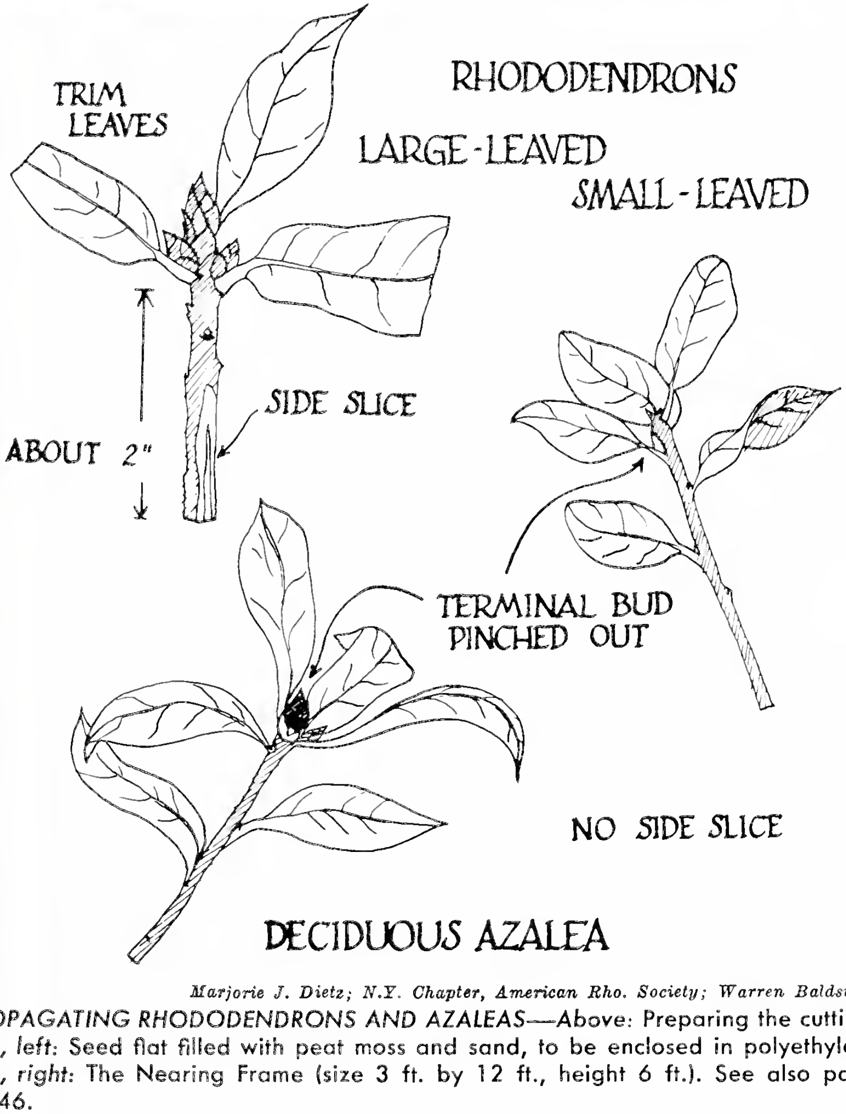
If a greenhouse is available this is probably the best way to root cuttings in terms of time and percentage of success. In addition, cuttings may be taken through January. There are various methods for rooting cuttings in the greenhouse, but they all share one thing in common that insures success: bottom heat in the rooting medium. The temperature of the bottom heat should be kept between 70 and 75 degrees F. and the easiest way to do this is with thermostatically controlled electric soil heating cables. The variations in method then consist only in ways of keeping the humidity high enough to maintain the cuttings in good condition. This may be accomplished by using mist nozzles, humidifiers or by building a polyethylene tent over the rooting bench. If the greenhouse air temperature is kept low, the moisture rising from the warm peat moss will condense on the plastic and maintain humidity around the cuttings. This method requires very little care.

Cuttings should be taken from the current year's growth. It has been found that thin cuttings, without flower buds and taken from the shaded side of the plant, root best. Wound the cutting by removing a slice of the bark down through the cambium layer (see drawing). On large cuttings, two slices may be made, one on each side. Then the cutting is dipped in a rooting hormone, such as Hormodin No. 3, and inserted in the rooting medium. Space far enough apart so that leaves do not overlap. If leaves are large, they may be cut in half.

Deciduous rhododendrons or azaleas may be rooted by treating them as early summer cuttings. The problem is that unless the rooted cutting is forced to put on growth after rooting, it will not break into growth the next spring. Forced growth may be accomplished by increasing the day length with artificial light. The cuttings should be allowed to go dormant during the winter, but protection is needed to prevent bark split the first year.

Layering—The oldest, simplest, but slowest method to propagate is by layering. Take a branch which can be bent to the ground. Wound it at the point at which you want it to root, stake to the ground with a hairpin-like wire and cover with leafmold. Then mulch, and in one to two years it will root. It may then be severed from the parent plant and grown under lath shade before planting. Often layers form naturally without any help from the gardener, especially when low branches are in a moist leafmold mulch. ◆





Marjorie J. Dietz; N.Y. Chapter, American Rho. Society; Warren Baldsiefen.

PROPAGATING RHODODENDRONS AND AZALEAS—Above: Preparing the cuttings. *Top, left:* Seed flat filled with peat moss and sand, to be enclosed in polyethylene. *Top, right:* The Nearing Frame (size 3 ft. by 12 ft., height 6 ft.). See also pages 44-46.

Conn. Agricultural Experiment Station

Mountain-laurel (*Kalmia latifolia*) is a favorite among native shrubs and the state flower of Connecticut and Pennsylvania.

MOUNTAIN-LAUREL AND ITS PROPAGATION

Alfred J. Fordham

THE MOUNTAIN-LAUREL, *Kalmia latifolia,* one of the most beautiful shrubs of North America, grows naturally from the state of Maine south to Florida and west to Indiana and Tennessee as well as along the Gulf States from Florida to Louisiana. In New England, at least, mountain-laurel grows under the forest canopy and also in exposed sites, thriving equally well in swampy, or dry, gravelly areas. Under garden cultivation, it should be treated like a hardy rhododendron.

Natural Variants

Many cultivars of *Kalmia latifolia* have been selected as natural variants either in the wild or from nursery rows. Oddly enough, one of the first cultivars, *Kalmia latifolia* 'Rubra,' to appear in the records of the Arnold Arboretum, came from the English nursery firm of Veitch and Son in 1886. From native sources in early years, the Arboretum received such cultivars as 'Obtusata' (1886), 'Polypetala' (1870), and 'Myrtifolia' (1885).

Selections at this time of greatest interest to horticulturists are those with deep pink flowers or red buds, contrasting forms with white flowers, and a form (*fuscata*) with a deep pigmented band on the inside of the corolla. Results from research in the genetics department at the Connecticut Agricultural Experiment Station indicate that these kinds may be obtained true to type from seed of controlled crosses. New and improved types are being obtained from hybridizing and these forms, as well as the older ones, should be commercially available in years to come. Despite the fact that good garden forms were described a century ago, no cultivars of mountain-laurel have been listed in European or domestic nurseries. The omission can, no doubt, be explained by the fact that it has been considered difficult to root from cuttings and its propagation has been largely from seed.

Propagation from Seed

The five-chambered, globe-shaped seed capsules of mountain-laurel ripen in autumn and later split to release their seeds. Seed examined in December shows some,

Mountain-laurel variety *fuscata* has attractive flowers with purple-brown bands.

Mountain-laurel 'Polypetala' has divided corollas, giving untidy appearance.

but not all, capsules open but only at their tops. Nature's design prevents spilling of the minute seeds, yet allows high winds to whip them out and carry them away from the mother plant. A dispersal adaptation such as this leads to wide latitude in collection time and one can expect to find some seeds remaining in the capsules throughout the winter.

Most very small seeds do not benefit from pretreatment by cold; mountain-laurel, however, is an exception. Germination of 20 to 50 per cent can be obtained without stratification but it is increased and unified if its seeds are subjected to a cold treatment. This can be accomplished by sowing the seeds in pots or other containers and placing them out-of-doors for the winter in a sheltered location such as a coldframe. An alternate method of stratification would be to put the containers of sown seed in a polyethylene plastic bag which is bound at the mouth with a rubber band to make it vapor-proof. The cold requirement is then satisfied by putting the bag in a household refrigerator for three months.

Propagation from Cuttings

At the Arnold Arboretum the propagation of broad-leaved evergreens has been carried out under polyethylene sheets for many years. Under polyethylene, mountain-laurel cuttings do not suffer the leaching of nutrients and yellowing which occurs in cuttings rooted under mist. The groups of mountain-laurel cuttings were tested under the plastic and under mist for comparison. Each group was divided into two lots. Lots No. 1 were placed under polyethylene while Lots No. 2 were placed under mist. Results are expressed in the following table:

Under Polyethylene
Lot No. 1—90%—Rooted
Lot No. 1—90%—Rooted

Under Mist
Lot No. 2—50%—Rooted
Lot No. 2—30%—Rooted

Mountain-laurel cuttings are made from the current year's growth and can be taken as soon as the growth ripens, indicated as color changes from light green to dark green. Softwood cuttings have rooted poorly in tests, but hardwood cuttings, taken from August to December, have rooted successfully.

The cuttings are prepared for insertion into the rooting medium by cutting the stems to a uniform length, removing any leaves that would be below the rooting medium, and wounding the cuttings so that they will produce a larger mass of well distributed roots. This is accomplished by slicing two slivers of rind downward for a distance of 1 to 1½ inches on opposite sides at the base of the cutting. This procedure removes a physi-

Arnold Arboretum

Structures used at the Arnold Arboretum for propagating under plastic.

cal barrier and exposes more surface to the action of the root-inducing hormone. Wounding both sides of the cutting is important to prevent a lopsided root ball which is difficult to manage without damaging the new roots. Deep wounds, which cut through the rind and take part of the wood, are more satisfactory than shallow wounds which can heal over quickly and lead to what is essentially an unwounded cutting.

Hormone Treatment

After the cutting has been prepared, it is treated with a root-inducing hormone. At the Arnold Arboretum, mountain-laurel cuttings have been tested with an assortment of such hormones. The two most effective treatments were a five-second dip using IBA plus NAA at 5,000 ppm each or treatment with a powder formulation of 2,4,5-TP at 1,000 ppm. Because of clonal variation there were instances in which the IBA plus NAA was a slightly better treatment, while in other cases, 2,4,5-TP was superior. It should be added that mountain-laurel roots slowly, taking from four to six months under plastic.

The use of polyethylene chambers has some distinct advantages. Nutrients do not leach from the cuttings, which can happen under mist. The chambers are carefree and can be left for weeks on end without attention. There is little chance of loss through mechanical or human failure. In areas where hard water presents a problem, there is no build up of substances on the cuttings. Many subjects normally considered difficult can be rooted in high percentages.

The propagating chambers used at the Arnold Arboretum are constructed on peninsular type benches 6 feet long, 5 feet wide, and 6 inches deep. The benches are made of three-quarter-inch transite. They are first lined with two-mil polyethylene film, then 1½ inches of medium is placed in the benches, and heating cables installed at that level. The bench is then filled with a medium of equal parts sphagnum peat moss and horticultural grade Perlite. Welded joint wire of 2-by 4-inch mesh is used to support the two-mil polyethylene covering. It is known as turkey or utility wire. The frames are fashioned to hold the plastic about 10 inches above the rooting medium. Bottom heat is maintained at 75°F.

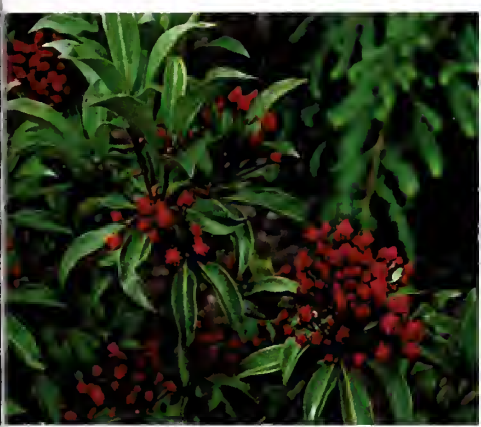
After cuttings are inserted, the medium is watered so that it will settle around the cuttings. The transite bench sides are wetted and the polyethylene film is placed over the framework and down over the wet transite. It clings tightly, permitting air penetration but is vapor-proof.

Temperatures outside the propagating structure are cooler and, therefore, water continually condenses on the inner surface of the plastic. It accumulates in droplets which become too heavy to remain and fall back onto the cuttings and into the medium.

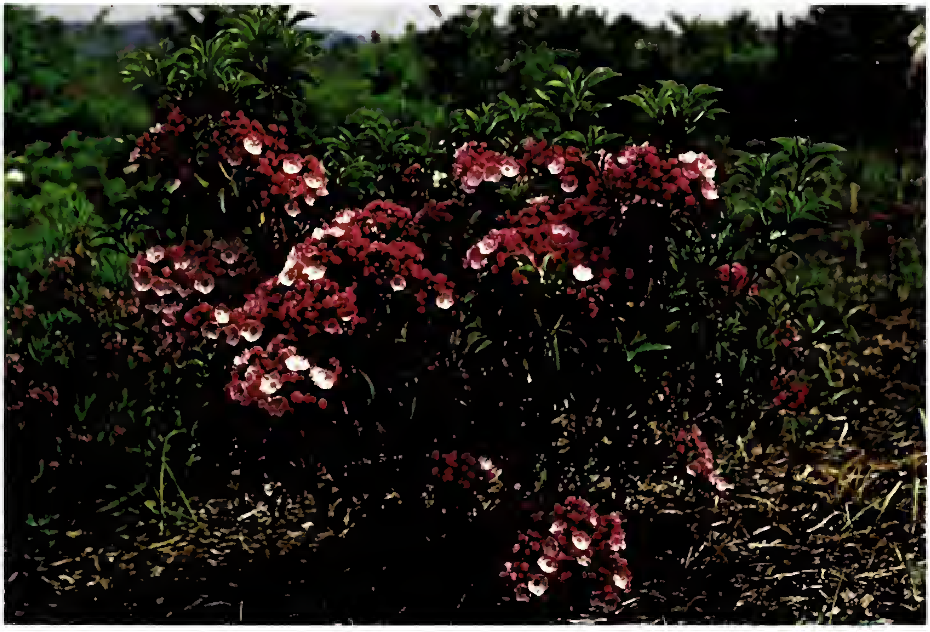
On cloudy, humid days the coverings are removed and the cases are checked for fallen leaves and dead cuttings. These are removed as a sanitary measure. An inspection at this time reveals whether the medium is drying or if infection is occurring. Before replacing the polyethylene, a spray application of 50 per cent Captan wettable powder at the rate of 2 teaspoons to the gallon is applied as a precautionary measure. This would only be necessary once in several weeks. ◆

Pink flowers of the common mountain-laurel *(right)* are familiar to those who have admired this native shrub in the wild and in gardens, but red-budded and red-flowered forms (below) are a revelation. Actually, variants of mountain-laurel are not new—the problem has been how to propagate them.

Richard A. Jaynes



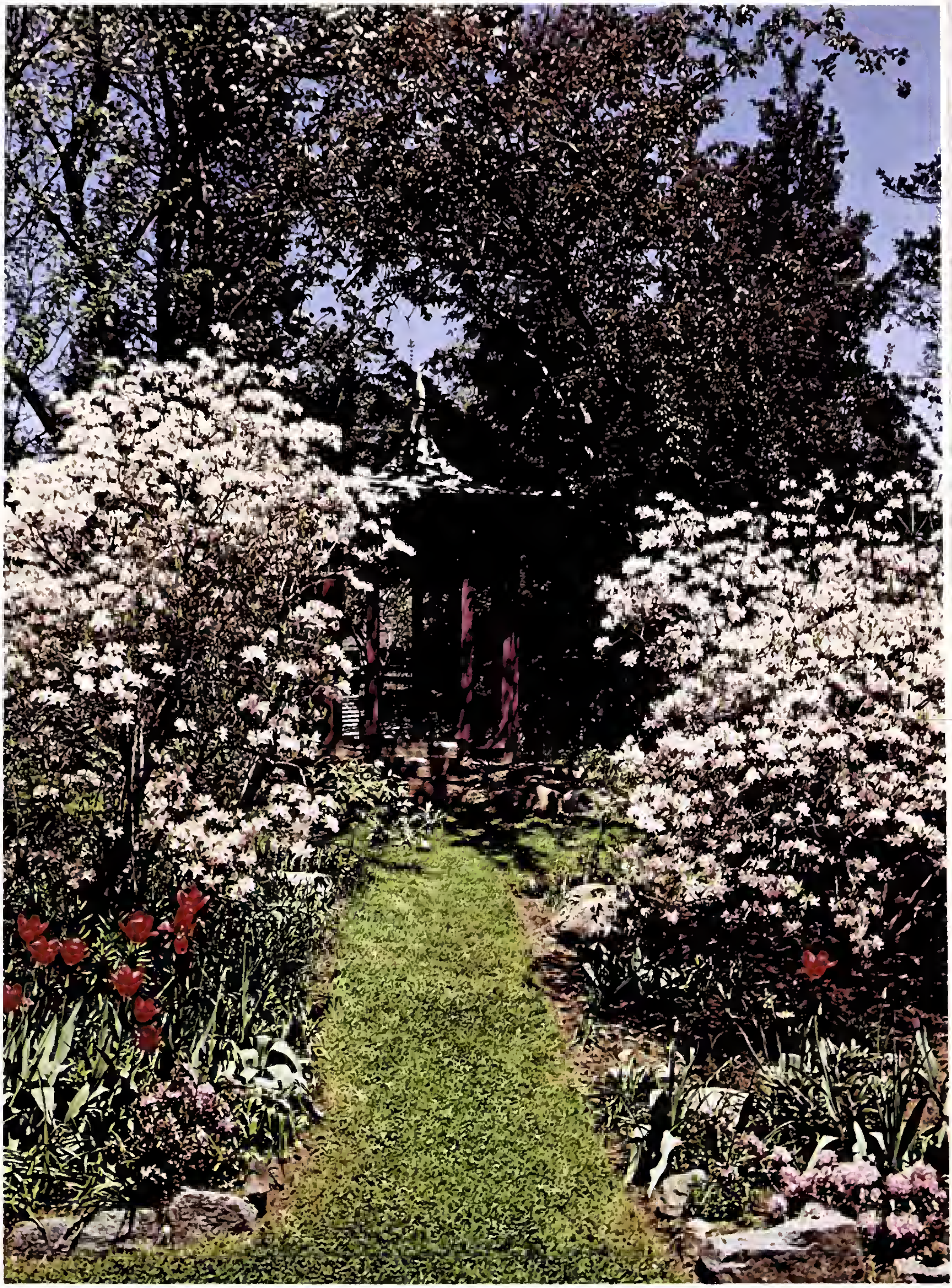
Nelson Groffman



A yellow-flowered deciduous azalea in full bloom in the Planting Fields Arboretum on Long Island. Its companion is a blue scilla.

Marjorie J. Dietz

Shammarello hybrid rhododendrons, including white 'Belle Heller,' in a Long Island woodland garden. The flowers of 'Belle Heller' are marked with a gold blotch.



Nelson Groffman

The native deciduous azaleas, especially those which bloom before their leaves unfurl, contribute lightness and grace to the spring garden.

Rhododendron smirnowii

Azalea 'Sarabande'

Rhododendron keiskei

Azalea 'Louise Gable'

Rhododendron 'Mrs. Charles S. Sargent'

Azalea 'Narcissiflora'

All photographs by George Kalmbacher

THE CARE OF RHODODENDRONS AND THEIR RELATIVES

Harvey Gray

RHODODENDRONS, azaleas, pieris, mountain-laurel, leucothoe—and other "acid soil" plants that gardeners are familiar with—are more closely related to each other than to other plant groups. Botanists place them in the *Ericaceae*, or heath family, and sometimes refer to them as "ericads" or ericaceous plants.

Some, like the rosebay rhododendron (*R. maximum*) and highbush blueberry (*Vaccinium corymbosum*), are often found in the wild in swamps high in organic matter. Others, for example, heath (*Erica*), heather (*Calluna*) and bearberry (*Arctostaphylos uva-ursi*) frequently grow in sandy locations in the wild. In the garden both groups usually thrive in a well-drained, distinctly acid soil of good organic content, most easily supplied by peat moss.

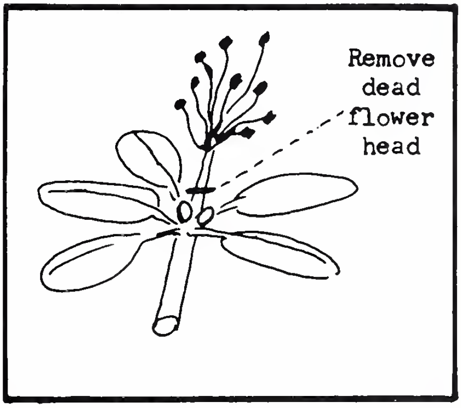
Unless a gardener lives in an alkaline soil area where the growing of rhododendrons and their kin becomes a special problem (raised planting beds are often the solution in such areas), the first point to consider when planting is light exposure. Most gardeners think of them as "shade lovers," yet shade conditions, without light or filtered sunshine, are rarely satisfactory for most ericaceous plants. Filtered sunshine, such as can exist in woodlands where surplus tree growth and lower limbs of the remaining trees have been removed, encourages well formed and proper blooming plants.

Also, it should be noted that the delicate flower shades of pink and lavender bleach quickly in strong light. Another point to consider: full sunlight with accompanying high temperatures shortens the blooming period.

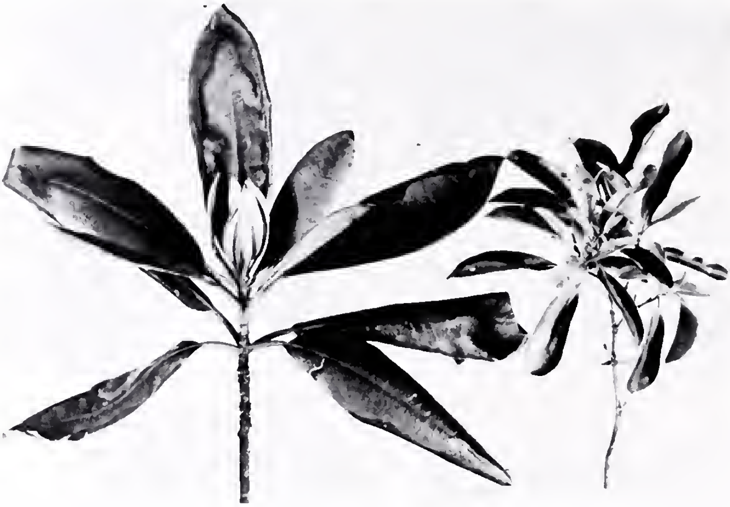
Brisk winter winds and clear days, in the presence of very cold temperatures and frozen soil, often result in foliage burn on evergreens. The symptoms become evident in spring—dark circular spots along the margin of the leaves. New gardeners, seeing it on large-leaved rhododendrons, often mistake the burn for a leaf disease.

Normally hardy plants, when sheltered from strong winds and with the soil well mulched to prevent deep freezing, are rarely affected by foliage burn or winter kill, even though they may be exposed to winter sun. Dense conifers like arborvitae and young pines form excellent windbreaks and at the same time make an attractive background for both evergreen and deciduous members of the heath family.

Large-leaved rhododendrons can be grown on the north side of a wall, but when planted on the south or west sides of walls may be injured by reflected light and heat in summer or winter. Avoid placing them off the corners of building walls, for such locations are especially windy and cold in winter.



Preventing seed formation increases flower production for the next season.



Buhle

Winter burn on rhododendron (left) and mountain-laurel.

Often, rhododendrons and similar plants in drafty spots are successfully protected in the cold months by evergreen boughs, burlap enclosures or plastic shields, but artificial screens of this sort are no addition to the winter landscape. A much better idea is to study the possible adverse winter conditions around the property, for this can result in plantings that are attractive year-round.

Planting

Most rhododendrons are bought "balled and burlapped" or in containers with soil around the roots. Dig the hole 6 or 8 inches deeper than the depth of the ball, and make sure that the diameter of the hole is twice that of the ball diameter. Thoroughly mix equal amounts of light sandy loam and peat moss—or if available acid leafmold from oak or pine trees. Put the mixture in the hole, tramp firmly, then place the plant so the top of the ball is flush with the ground level. Add the mixture around the sides of the ball, lightly firming as planting progresses. When the hole is full, form a saucer of earth about 4 inches high around the plant "pocket." This will facilitate proper watering in the first season.

Fertilizers and Mulches

Immediately after planting, a small amount of the granular form of 10-6-4 lawn fertilizer may be scattered within the ring of the saucer. One to five handfuls, depending on the size of the plant ball, is enough. To cover a large area, apply at the rate of two pounds per hundred square feet. There are various fertilizers especially formulated for rhododendrons; which are often composed mostly of organic fertilizer such as cottonseed meal. Apply according to directions on the package. Then, water deeply so the soil will settle around the ball and the fertilizer will go to work quickly. Similar light applications of fertilizer may be beneficial in succeeding autumns, some time after visible growth has stopped, but before the ground freezes. All woody plants take in nutrients until soil temperature drops below 35 F. What is not used in winter will be readily available in spring when new growth starts.

Ericads dug with a generous-sized ball

or ones that are container-grown may be planted almost anytime the soil is not frozen. Ideal times in the Greater New York area: mid-August to mid-September, and the month of April. Regardless of when these plants, most of which are by nature shallow-rooted, are set out, they should be heavily mulched to conserve moisture and minimize winter injury. Coarse materials like pine needles, partially decomposed leaves of oak or beech, alone or in combination are satisfactory; also decomposed wood chips or, in winter, salt hay.

Long-term use of fertilizer and mulch may result in soil that is excessively acid—even for rhododendrons and their kin. Optimum pH for most all ericads is between 5.0 and 5.5, and if it falls below 4.8, a light application of dolomitic limestone, broadcast at one pound per 100 square feet in sandy loam, can be beneficial. This form of limestone also provides magnesium and calcium, which are deficient in many soils. In areas where the pH is high, it can sometimes be satisfactorily lowered by the use of powdered sulfur. Submit a soil sample to your local state experiment station to determine pH and the effective application rates of corrective amendments for your soil type. Some gardeners prefer to use one of the inexpensive colormetric test kits that many garden supply stores stock.

Most ericaceous shrubs rarely need much pruning, but it helps to be familiar with some of the different kinds of growth habits that occur in the family. Knowledge of these growth habits can help you make the plants look—and perform—their best. First, let's examine three of the most widely known ericaceous plants—rhododendron, pieris (or "andromeda" as it is sometimes misleadingly called) and mountain-laurel (*Kalmia latifolia*). They are "surge" growers. Vigorous young plants may make three different surges between spring and autumn. Such vegetative growth usually discourages the normal summer formation of flower buds, and flowers on young surge growers are few or nonexistent in the succeeding spring. Older shrubs of this kind make only one surge, and their flower buds are typically set in July or early August.

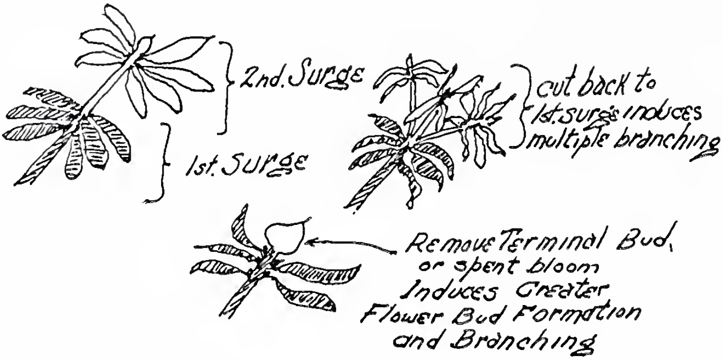
After bloom, it is a good practice in the small garden to remove the spent flower heads—before seeds ripen—on surge growers like rhododendrons and mountain-laurel. This will help insure a wealth of flowers each year. Seed development prevents the active growth of the vegetative buds located just beneath the seed capsules.

Occasionally, young "surge" growers become lanky. To discourage excessive vegetative growth and to promote more compact plants, it is sometimes desirable to cut off the second surge of growth at its base before it advances to any great length. Of course, this will inhibit flower bud formation (which is not likely to occur profusely anyway in the vigorous young plant), but in the long run it can result in a better plant and obviate the need for severe pruning in later years.

Azaleas, both evergreen and deciduous ones, are "continuous" growers. Young ones will begin top growth in spring and, in the New York area, may not stop until nearly autumn. In older plants, such activity usually comes to a halt in early July and is followed by the development of flower buds for the succeeding spring's bloom.

Azaleas don't develop side branches once the shoots emerge from the vegetative buds formed the previous year. Frequent result: a loose open shrub. Prevention: pinch the soft new shoots of vigorous young plants once or twice early in the growing season. The lateral vegetative buds located in the leaf axils (the points where leaves are attached to the twigs) come into growth shortly after the tip removal. Don't pinch after early August, for it can cause poor flower bud set and winter injury to the tender new shoots.

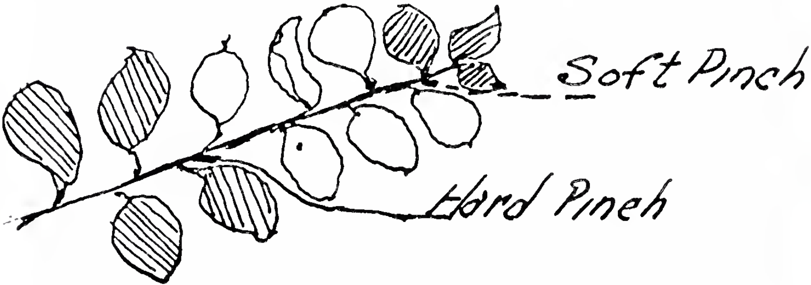
Mature deciduous azaleas generally do not respond to summer pinching, but seedlings can be induced to branch by an early season pinch. Young plants of the semi-evergreen azalea, *Rhododendron obtusum* (and its many variants), are often sparsely branched and, while they com-


2nd. Surge
1st. Surge
cut back to 1st. surge induces multiple branching
Remove Terminal Bud, or spent bloom Induces Greater Flower Bud Formation and Branching

Drawings by author

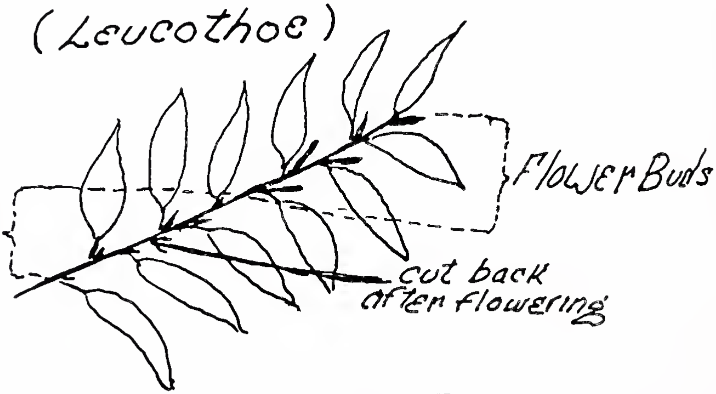
SURGE GROWER

(Azaleas)



CONTINUOUS GROWER

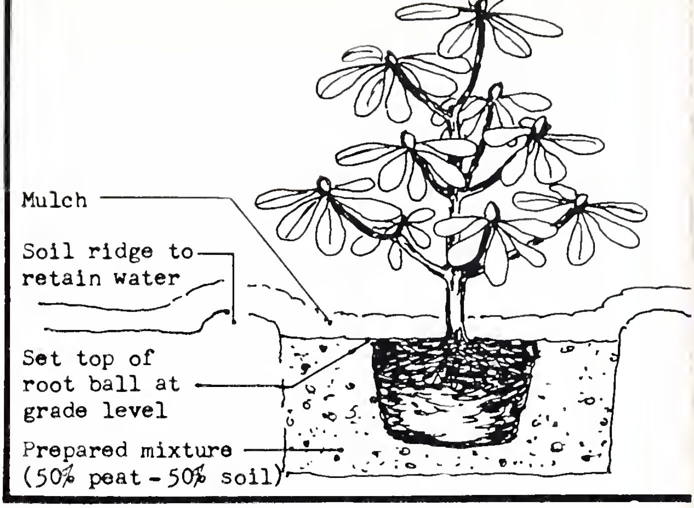
(Leucothoe)



BASAL GROWER

Planting a large-leaved rhododendron — or most other ericaceous shrubs. With balled and burlapped plants, it is often recommended that burlap be removed and soil around ball be slightly loosened so roots will be in immediate contact with surrounding soil in the hole.

N.Y. Chapter, American Rhododendron Society


Mulch
Soil ridge to retain water
Set top of root ball at grade level
Prepared mixture (50% peat - 50% soil)

monly lose this characteristic at maturity, one or two pinches in July and early August may hasten the process. If a very large number of azaleas are involved, as in a naturalized garden, pinching may be neither feasible nor especially important for horticultural effect. Nurserymen growing large quantities of azaleas customarily shear the young plants or destroy the growing tips chemically.

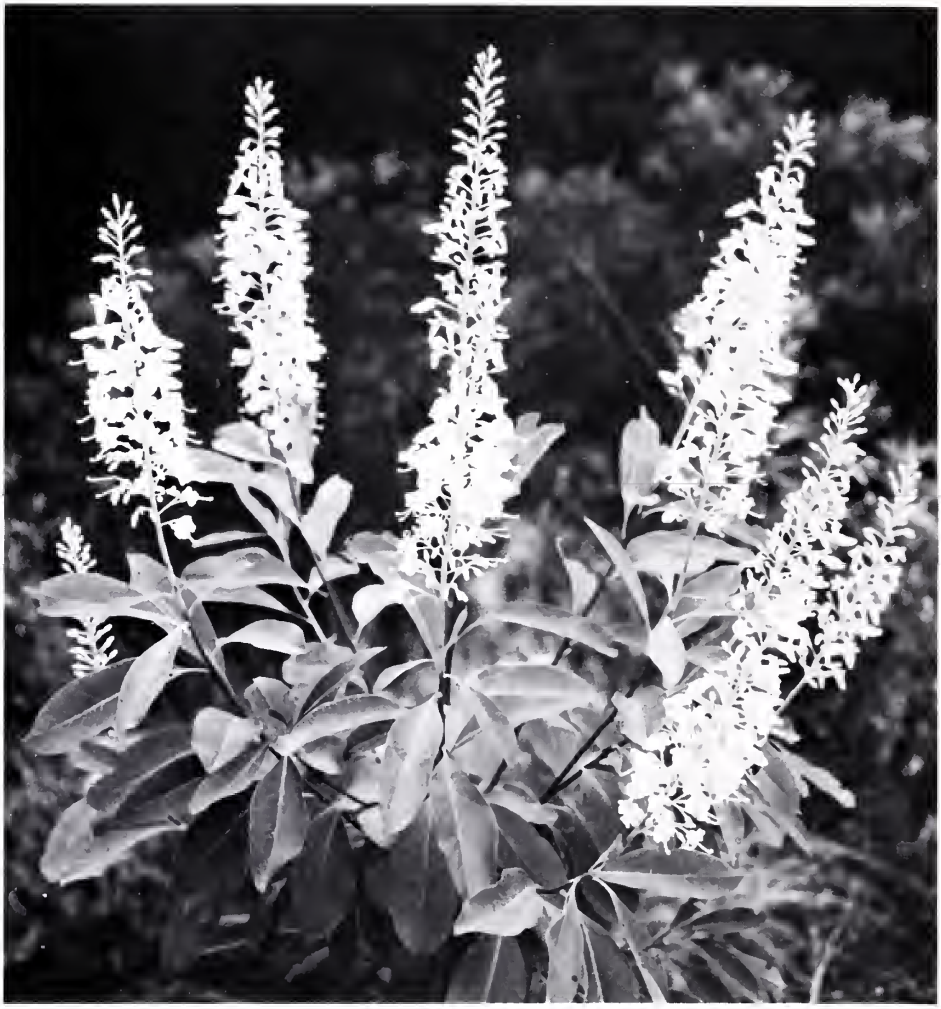
A third type of growth habit is encountered in another ericaceous shrub, leucothoe. It is what might be termed a basal grower, since shoots commonly grow from ground level. (Forsythia and deutzia have this habit, too.) The branching of leucothoe is sparse, and plants may become straggly if left to their own devices. The best way to insure well formed specimens is to prune back to non-flowering wood right after bloom; also remove a few of the oldest shoots from ground level at the same time.

In the South, azalea petal blight is a serious problem, especially on Kurume and Indian azaleas. The flowers become badly spotted and can mar the beauty of a planting when it should be at its peak. Best protection in the average-sized garden: pick and destroy diseased flowers immediately. Don't let them fall to the ground, where the pathogen will overwinter on the decomposed flowers. In a large garden, spraying the ground with ferbam before bloom time may be effective; or spray the flowers with a fungicide containing zineb just before and during bloom.

Once started, root rots, such as those that occur on rhododendrons in wet and heavy soils, are nearly impossible to control. Careful attention to planting site and soil preparation are the best preventions.

Nematodes, which are minute eelworms and not a disease, sometimes attack the fibrous roots of ericaceous plants. Their presence results in a sparse, shallow root system and poor top growth. Bear in mind that these symptoms can have other origins and, in case of doubt, professional assistance in diagnosis may be desirable. If nematodes are found to be present and the plants are not yet severely affected, a nematicide such as Nemagon or Nemafume will control them. As with any pesticide, follow label directions strictly. Malathion and Sevin control such pests as lacewing flies and thrips.

To date, chlordane has provided an effective soil treatment for leaf-chewing insects, day and night feeding beetles, as well as taxus weevil and beetle grubs working on the plant roots. Basal bark chewers and borers have in recent years been controlled with lindane. There are not yet any satisfactory substitutes for chlordane and lindane for these purposes, but the use of the two chemicals is at this time restricted in some states. In New York, a current practice is for gardeners to be in touch with commercial spray firms licensed to use these chemicals. For up-to-date information in other states, consult your county agent or state experiment station.◆



Kenneth Rogers

G. A. Rogers

Above: The Georgia-plume *(Elliottia racemosa)* in full bloom in the Charles C. Harrold Nature Preserve in Georgia. *Left:* A fruiting raceme from a plant in the Ten Mile Creek Area, Bulloch County, Georgia.

GEORGIA'S RARE PLANT—ELLIOTTIA

The Georgia-plume is a little known member of the heath family

Edgar T. Wherry

ALTHOUGH the Georgia-plume (*Elliottia racemosa*) is recorded to have been introduced into cultivation in 1813, this striking member of the heath family has never become widely known or used. While it may develop into a tree up to 35 feet tall with a 10-inch trunk, it usually forms a shrub of moderate size. The deciduous leaves resemble those of our native azaleas. In early summer multiple branch-tips send out showy racemes of numerous flowers, each with four pure white petals—unusual for the heath family in being separate—and a protruding up-curved style. Their mild fragrance attracts many bees and other insects, but because of partial self-sterility, seeds are produced only when plants of different parentage grow near together. The first seeds ever recorded—also unusual in being winged—were found at the Salem Church locality in 1936.

Georgia-plume grows in the Coastal Plain of Georgia (with one extension into South Carolina) in strongly acid and sandy (in one case rocky) soil ranging from very dry to moderately damp. (The attribution of it to wet soil in an Arnold Arboretum Bulletin in 1938 was a misobservation, but, alas, has been widely copied in horticultural compilations.) Rehder classes it as hardy up to Zone VII of the Arnold Arboretum Hardiness Map but it has long been thriving in the subacid gravel of the Henry Foundation for Botanical Research at Gladwyne, Pennsylvania, high in Zone VI. The tradition that it is "difficult" to cultivate, and its absence from the horticultural trade, are presumably due to its being set out in too rich or too wet soil.

After its discovery by early botanists, native haunts of Georgia-plume were long "lost," but in the 1900's Dr. Roland M. Harper found several stations. In 1923, employed as a part-time botanical explorer by the U.S. Department of Agriculture, I was asked by Dr. Frederick V. Coville to study its occurrence. I visited Georgia in company with H. W. Trudell, an amateur botanist of Philadelphia. On this trip most of Dr. Harper's colonies were relocated and a new one near Metter in Candler County added. Told of this, Dr. Wallace A. Kennedy, a local physician, kept on the lookout, and found an especially luxuriant one at Salem Church nearby. To save this from the destruction which has overtaken most colonies, his friend Dr. Charles C. Harrold of Macon purchased 72 acres on which it grows; after his death, Mrs. Harrold gave this reserve to Clermont Lee and Franklin R. Dulany of Savannah, and they in turn deeded it to the Nature Conservancy as the Charles C. Harrold Nature Preserve.

During the last ten years there has been a most favorable development—the arousal of interest in the Georgia-plume on the part of resident botanists in that state itself. Most active are members of the faculty of Georgia Southern College at Statesboro; they have even named a serial publication of notes from their herbarium, *Elliottia*. Professor John R. Bozeman reports the finding of several new stations of it, and Dr. George Rogers, director of their botanical garden, guides its successful culture there, in part of material barely saved "from the bulldozer." Professor Wayne R. Faircloth of Valdosta State College has published in *Castanea* an account of the first known colony on a rock outcrop.

We can now feel assured that *Elliottia* will not suffer the same fate as did Bartram's *Franklinia*—complete extermination in the wild. ◆

HEATHS AND HEATHERS

After rhododendrons, the largest ericaceous plant group . . .

Pamela J. Harper

THE TERM "heather" is often collectively applied to the genera *Calluna* and *Erica,* though strictly speaking, only *Calluna* is heather, and *Erica* is heath. There is but one species of heather, *Calluna vulgaris.* Although associated in the minds of poets and gardeners with the hills and moors of Scotland, it is also native to northern Europe and Asia Minor.

Heather cultivars (of which there are over 200) range from tiny dense buns to erect shrubs 2 feet tall, sometimes more. Foliage and flowers vary, too, and there are a number with double flowers. Many plantsmen, particularly rock gardeners, value the heather for its long flowering period in summer and autumn as well as for its fine leaf texture.

The genus *Erica* is superfically similar to *Calluna,* but it has over 600 species. The great majority, including the pot-grown florists' plants sold as heather—the Cape heaths—are native to South Africa and are not hardy outdoors in the United States except in cool, moist climates like that encountered in the San Francisco Bay area of California.

However, a few *Erica* species are native to Europe and from these have originated a number of cultivars and hybrids that are grown in the cool-temperature parts of America. The most commonly encountered European species is *Erica carnea,* which northern gardeners especially appreciate for its late winter and early spring flowers.

Botanically, there are differences in leaf and flower between *Calluna* and *Erica. Calluna* leaves are tiny, packed in fours around the stem—giving the twig a squared appearance—and are closely overlapping. The divided calyx is the most conspicuous part of the flower. *Eri-*

The heath *Erica carnea* 'Springwood White' begins to flower in March and continues the display for weeks. Here it sprawls over the top of a rock wall, but it also can be an impressive ground cover.

Genereux

A heather garden on Cape Cod. The plants are so established that it is difficult to believe they are the introduced rather than original plants of the site.

ca has separate needle-like leaves and the urn-shaped corolla is the colorful part. If, then, the flower has "petals," it is *Calluna*. If the flower resembles a globe, it is an *Erica*.

The Pacific Northwest and adjacent parts of British Columbia offer ideal growing conditions for *Calluna* and *Erica*. English literature on heaths and heathers is appropriate for these areas. Another useful reference: John A. and Carol L. Grant's *Trees and Shrubs for Pacific Northwest Gardens* (Seattle: University of Washington Press, 1967).

Calluna and *Erica* have been grown in the United States since colonial times, and have become naturalized on Cape Cod and in similar maritime areas. There is still need for further testing in certain parts of the country. They are being grown with varying degrees of success in gardens from North Carolina to Vermont and along the coast in southern Maine and west to Ohio (primarily *E. carnea* in Ohio).

Winter protection is advisable north of Virginia unless lasting snow cover can be relied upon. Sooner or later comes the cold, dry winter with bright sun, wind and absence of snow which causes heavy casualties among unprotected plants. Evergreen boughs, straw, salt hay or similar coarse material can be used, the object being not so much to keep out the cold as to prevent dehydration of the foliage.

Basic growing needs are an acid soil (pH 6 or lower) that is preferably light and sandy, perfect drainage and regular pruning. Sand or fine, crushed stone (*not* limestone) can be worked into heavy soils if an improved soil texture is desirable. In sandy soils low in humus content, generous amounts of peat moss should be mixed in the planting holes. Fertilizer should not be used. A year-round mulch helps conserve moisture and discourage

Photographs by Marjorie J. Dietz

Heathers (*Calluna*) mulched with buckwheat hulls.

weeds until plants "meet up." It can consist of shredded bark, rotted sawdust, peat moss of the coarse and lumpy kind, stone chips, pine needles or leafmold. With the exception of a few rock garden dwarfs, all *Calluna* and *Erica* need annual shearing, which should be done just as new growth begins in spring, at which time most of the previous year's growth should be removed.

Sun for half a day is sufficient, and preferable in hot and humid areas. A north or east-facing slope or a raised bed makes a good site. These plants will not prosper in arid conditions and will die if the soil dries out completely but still less will they tolerate constantly wet roots. Continual watering should be avoided as it encourages shallow roots.

A combination of heavy rain and hot sun occasionally causes foliage to brown. This is apparently due to a fungus which flourishes under such conditions. Attention to cultural requirements will minimize this problem, but dusting with sulfur in early summer seems to provide temporary relief, as it does against powdery mildew.

Calluna and *Erica* are valuable ground cover plants, one of the very best for this purpose being *Erica carnea* 'Springwood White.' The bushier *E. c.* 'Springwood Pink' is almost as good, and so is the new *E. c.* 'Pink Spangles,' which has lilac sepals and rosy bells of exceptional size. *E. c.* 'Foxhollow Fairy,' which has creamy pink bells, also spreads quickly.

Heathers in a home garden are mulched with pine needles.

Calluna 'Foxhollow Wanderer' is a rugged, spreading plant, six inches high with dark foliage and purple flowers. The hybrid 'Dawn' (*E. ciliaris* x *tetralix*) is vigorous and long flowering, responding to more moisture than most. *E.* 'Williamsii' (*E. tetralix* x *vagans*) is a reliable spreader. It has foliage gold-tipped in spring and bronze in winter, and the flowers are pink.

For the rock garden *Calluna* 'Multicolor' is outstanding. It grows slowly to 6 inches and the foliage is varying shades of green, gold, red and bronze. *C.* v. 'Sister Anne' has downy foliage of softest green overlaid with purple to give a dark gray appearance, plus curled sprays of rose-pink flowers on a plant just a few inches high. *Erica cinerea* 'Coccinea' is the best dwarf of that species (carmine red flowers, height to 4 inches), though seldom long lived. Perhaps the best heather of all for rock gardens is 'Foxii Nana,' a tight, congested bun of firm foliage, slow growing to a height of 3-4 inches with sparse lavender flowers.

Sprays of *Erica carnea* cut in March are especially welcome in the home because there is little else in flower in the garden then. For cut flowers in summer *Calluna* 'H. E. Beale' (tall, double pink) and its double-flowered sports 'Elsie Purnell' (taller, foliage grayer, flowers paler) and 'Peter Sparkes' (more compact, foliage darker, flowers deeper pink) are ideal. They also dry well as do most heaths

Various kinds of heathers thrive in this sunny site at the edge of a woodland. The soil is well-drained, acid and predominantly sandy. At the time the plants were set out, a generous amount of peat moss was mixed in each planting hole.

and heathers. 'Mairs Variety' is a good tall white for summer cutting, but not in my opinion as attractive in the garden as other white heathers.

Although *Calluna* and *Erica* are perhaps most commonly thought of as rock garden plants, they also look well in the foreground of shrub plantings. For this purpose they should be spaced approximately 18 inches apart. As with many other small plants, the best effect occurs when they are planted in groups of three or more.

There are several ways to propagate *Calluna* and *Erica*. Layering is one of the easiest, except for *Erica cinerea,* which is reluctant to root. Species can be grown from seed, but cultivars of course won't breed true. The most common method of propagation is by cuttings. They are best taken in spring for *Erica,* in late summer or autumn for *Calluna*. The cuttings (tip or heel), about an inch long, should be of the current year's growth but mature enough so they don't wilt when taken. Larger cuttings can be rooted with a mist system. Bottom heat hastens late autumn rooting. There is no need to remove leaves from the cuttings, nor to use a rooting hormone, although some growers do both. Rooting mixture: equal parts of peat moss and coarse sand.

Plastic storage boxes with transparent tops are good propagation containers. Make drainage holes, put in 2 inches of the soil mixture and insert cuttings half an inch apart. Firm the mixture around them, and water finely and lightly. Put the cover on and place the box outdoors near a north wall or other shaded spot. Enclosed propagating boxes rarely require additional water. Cuttings are more likely to fail from too much watering than too little. Do not allow the cuttings to freeze—a sheltered coldframe, a cool windowsill indoors, or very protected wall should prevent this. Plant them in the open ground in spring.

Most cultivars of *Calluna* and *Erica* originated in England. British books that contain detailed descriptions and much useful information include: Fred J. Chapple's *The Heather Garden* (London:

There is great variety among heathers as is shown by this *Calluna* 'Kuphaldii,' which exhibits a "weeping" form.

This nursery planting of heathers has been mulched with ground sugar cane.

Collingridge, 1960); D. Fyfe Maxwell's and P. S. Patrick's *The English Heather Garden* (London: Macdonald); and T. Underhill's *Heaths and Heathers* (Newton Abbot: David & Charles, 1971). Remarks from British writers as to relative merit are not always applicable to the eastern U. S. For example, *Erica carnea* 'Vivellii,' apt to be of poor constitution in England, is one of the hardiest cultivars of that species here. Two outstanding *Calluna* cultivars, 'County Wicklow' and 'J. H. Hamilton,' flower briefly in England but longer here.

American gardeners are welcome to join the Heather Society, a British membership organization. Details can be obtained from the Secretary, Mrs. C. MacLeod, Yew Trees, Horley Row, Horley, Surrey, England. The Society issues a Yearbook and periodic bulletins. One of the objects of the Society, which is the international registration authority for heaths and heathers, is to clarify nomenclature, and to this effect it has published a helpful booklet by David McClintock, *Guide to the Naming of Plants* $1.00).

Following is a list of *Calluna* and *Erica* cultivars additional to those already mentioned which I have found especially rewarding to grow. Some are rare, others are difficult to obtain locally, but all are available in USA and can be purchased from one or another of such specialist growers as those cited in the Brooklyn Botanic Garden Handbook 1200 TREES AND SHRUBS—WHERE TO BUY THEM, the classified sections of garden magazines, and on page 95 of this Handbook.

Heath and Heather Selections

Calluna vulgaris (Scotch Heather or Ling). Very hardy. Summer and autumn.
- 'Alba Rigida.' Stiff horizontal branches give a Japanese look; bright green foliage, white flowers, 6 inches.
- 'Beoley Gold.' Bright gold foliage, white flowers, 15 inches.
- 'Blazeaway.' Foliage gold in summer turning bonfire hues in autumn; mauve flowers, 12 inches (the new 'Sunset' and 'Robert Chapman' have even brighter foliage color but are scarce as yet).
- 'County Wicklow' (syn. 'Camla'). Shell pink double flowers, 9 inches.
- 'Crispa.' Bright green foliage, white flower, 15 inches. Apparently of American origin.
- 'Cuprea.' Coppery foliage; mauve flowers; 12 inches.
- 'J. H. Hamilton.' Clear pink double flowers; dark foliage; 9 inches.
- 'Mrs. Pat.' Unique, pink-tipped new growth; mauve flowers; 6 inches.
- 'Radnor.' Very free flowering double pink; very hardy; 9 inches.
- 'Silver Queen.' Woolly, silvery foliage; lavender flowers; 15 inches.
- 'Tenuis' (often sold as 'Rubra' in U.S.A.). Near scarlet; early; 9 inches.
- 'Tib.' Tall double; purple; 18 inches.

Erica carnea (Winter Heath). Very hardy. 6-9 inches. Most flower in March/April.
- 'December Red.' Bright pink; vigorous.
- 'King George.' The most compact and earliest; bright pink.
- 'Praecox Rubra.' Rosy red flowers; spreading habit; early.
- 'Vivellii.' Distinctive, bronze foliage; carmine flowers, late.
- 'Ruby Glow.' Dark green foliage; purple flowers, late.
- 'Snow Queen.' Less vigorous than 'Springwood White.'

Erica x *darleyensis*. (*E. carnea* x *E. mediterranea*). 15-18 inches. Prone to winter damage but rarely killed. Long flowering, often beginning in December. The pale pink cultivar first introduced was for many years marketed as *Erica* 'Darleyensis' or *Erica mediterranea hybrida*. Then came a white, known as 'Darleyensis Alba' with a multitude of synonyms. With the introduction of further cultivars in this category the name *Erica* x *darleyensis* was adopted for the whole hybrid group and our old friend is now, correctly, *E.* x *darleyensis* 'Darley Dale'—eclipsed now by selections with brighter flowers.
- 'George Rendall.' Compact; bright pink.
- 'Furzey.' Dark foliage; brightest pink flowers.
- 'Silberschmelze.' White.

Erica ciliaris (Dorset Heath). Not reliably winter hardy. Average height 1 foot but of sprawling habit. The following new introductions are among the prettiest.

'Corfu Castle.' Pinkish red.

'David McClintock.' Bi-colored bells of white and pinkish-mauve.

Erica cinerea (Scotch Heath). Temperamental, rarely long-lived; not very winter hardy. For those willing to take the risk the following cultivars are among the loveliest.

'Golden Drop.' Gold and copper foliage, 6 inches. Occasional purple flowers.

'Pink Ice.' Soft pink flowers, 6 inches.

'Eden Valley.' Bi-colored bells of white and lavender.

Erica mediterranea. Not reliably winter hardy. Spring flowering.

'W. T. Rackliff.' Bright green foliage; white flowers, 18 inches.

'Brightness.' Glaucous foliage; pink flowers, 18 inches.

'Superba.' Similar to 'Brightness' but 4 feet in height or more.

Erica mackiana. A 6-inch spreading plant which may be a true species or a form of *E. tetralix.* Moderately hardy in Maryland. *E.m.* 'Lawsoniana' has flowers of a paler pink and *E.m.* 'Plena' is a bright pink double.

Erica tetralix (Cross-leaved Heath). Summer and autumn flowering. Average height 9 inches. Very hardy but tends to die suddenly for no apparent reason.

'Alba Mollis.' Silvery grey foliage; white flowers.

'Con Underwood.' Crimson flowers; grey-green foliage.

'Pink Star.' Mid-pink flowers; soft grey foliage; 6 inches.

Erica vagans (Cornish Heath). Prefers near-neutral, rather heavy soil. Average height 15 inches. Root hardy but tops frequently split by winter cold.

'Lyonesse.' White.

'Mrs. D. F. Maxwell.' Cerise.

'St. Keverne.' Salmon pink.

Tree heaths. The only one reasonably hardy northward of Virginia is *Erica arborea* 'Alpina' but top growth is regularly damaged so seldom attains more than 3 feet.

Nature's own winter mulch—a blanket of snow—adds to the beauty of a heath.

Common—and not-so-common—relatives to serve in northern gardens as

CHOICE COMPANIONS FOR RHODODENDRONS

Harold Epstein

DESPITE their great diversity in foliage, flowers and growth habits, mass plantings of rhododendrons and azaleas can be enlivened by including other ericaceous shrubs, trees and ground covers in the original planting stage. Many of these relatives have a finer texture than rhododendrons and their contrast will help provide year-round interest. Nearly all ericaceous plants require acid soil in the garden, an important consideration in choosing companion plants for rhododendrons. Flowering times vary, so even the northern gardener, by careful selection, can have at least a few ericaceous plants in bloom over a fairly long period to add to the spring display of rhododendrons and azaleas.

The spacing between shrubs permits the use of various ground covers or under-plantings to create a complete landscape. The foreground can also be used for low borders of various subjects, herbaceous or woody. All of these smaller plants are easily moved as the major rhododendrons increase in size and shade the secondary plants. The use of groundcovers also retards the growth of weeds and consequently is an immense time saver.

The following, alphabetically arranged suggestions of ericaceous companion plants for rhododendrons are personal favorites and are recommended for use in the northeastern United States. Most have proved hardy in the suburban New York area. Some are currently available at nurseries, while others may require considerable effort to find.

Andromeda polifolia (Bog-rosemary) is a low-growing evergreen shrub inhabiting cool northern regions around the world, usually in peat or boggy soil. Many other plants have been included under *Andromeda* in the past—and are still occasionally so classified in the trade. Botanists today generally consider *A. polifolia* to be the only species in the genus, although *A. p. glaucophylla* of the eastern U.S. is also sometimes given specific rank. *A. p. angustifolia* and *compacta* are other variants. The dwarf forms from Japan, *nana* and *minima,* seldom over 6 inches tall, are neat and delightful subjects for most situations in the ericaceous garden. When sufficiently exposed to sunshine, the rose-pink urn-shaped flower bells are borne freely in late spring. It is an ideal companion among the dwarf rhododendron species, particularly those of the Lapponicum series (*R. fastigiatum, impeditum, russatum,* etc.), which also require considerable light to bloom abundantly.

Arcterica nana, the only species in its genus, is closely allied to *Pieris* and native only to northeast Asia. It is a slow growing and spreading evergreen shrublet 2-4 inches tall, with wiry stems and tiny, rigid, dark green polished leaves which take on bronze and reddish tones in winter. Above them, in early spring are borne many arching racemes of small pearly white bells resembling those of lily-of-the-valley. This exceptionally hardy plant, which does best in fairly exposed but moist, peaty soil, is a perfect companion for the most dwarf of rhododendrons. A fascinating gem, but rare in the nursery trade.

Arctostaphylos uva-ursi (Bearberry) grows wild around the world in the Northern Hemisphere. Hardiness varies,

Photographs by Marjorie J. Dietz

Bearberry (*Arctostaphylos uva-ursi*) creeps on a sandy bank near the shore.

and many distinct forms originating in the western U.S. are not dependable in the Northeast, probably in part because of hybridization with other species in the genus (see p. 93 for information on the western species that are called manzanitas). In the East, bearberry is common along many beaches, where it forms huge mats. It is a valuable, completely prostrate, evergreen ground cover for sunny or rocky areas with sharp drainage, which it requires. It is best to buy pot-grown plants, which will withstand very harsh conditions once established. Bearberry should not be planted with large-leaved rhododendrons in moist, peaty soil, but will associate well with small-leaved alpine sorts in high, rocky parts of the garden. The flowers are pinkish and urnshaped.

***Bruckenthalia spiculifolia* (Spike-heath),** a monotypic species from southeast Europe to Asia Minor, is a dense evergreen heathlike shrub growing 8-10 inches tall. It has small, bell-shaped pink flowers in terminal racemes in June. After many years of growing various heathers (*Erica* and *Calluna*), I have found this plant the most permanent and dependable of all under my conditions. A group of a few plants in the same area has persisted for 20 years without any coddling. They are occasionally sheared slightly after flowering to eliminate the dried flowers which tend to persist. This is a fine plant even in partial shade for planting among, or in the foreground of, large rhododendrons.

***Calluna vulgaris* (Scotch heather or Ling).** See p. 58.

Cassiope. Although there are about a dozen species (circumpolar and in the Himalayas) of these low, evergreen heath-

Bog-rosemary (*Andromeda polifolia*). To perform well, these plants must have a moist peaty soil and sunshine.

like shrubs, there are only a few that can be recommended to the keen horticulturist. They are all choice alpines with white bell-shaped flowers in spring, but prove to be most challenging in cultivation.

Cassiope lycopodioides, particularly the variety native to Japan, is the easiest to grow. (Also native to Kamtchatka, Alaska and British Columbia.) It is one of the most charming and distinct species, forming low compact mounds of interlaced stems from which arise, in the spring, little white bells on hair-like stems. Their total height is only 3 inches.

Cassiope 'Muirhead' (*wardii* × *lycopodioides*) is the easiest to grow of the several hybrids in cultivation. It is a marvelous plant, forming low clumps of gray-green stems up to 10 inches, which can produce quantities of large white bells. All *Cassiope* require lime-free peaty soil and a cool position in partial shade.

Chamaedaphne calyculata (Leatherleaf) is another monotypic circumpolar species. It is an upright, wiry, evergreen shrub to 3 feet or more. The April-to-June flowers are heath-like—little white urns borne along the arching branches. 'Nana,' a dwarf form, grows to about 1 foot.

Daboecia cantabrica is closely allied to the heaths and requires the same cultural conditions as *Erica*. Popularly known as "Irish-heath," it is native to western Ireland and western Europe as well as to northern Spain. There are various forms with different flower color. *D. cantabrica* is questionably hardy in many parts of the eastern United States, particularly north of Virginia. I have had several experimental plantings but they do not survive most winters. The plants appear to do better in some areas of Long Island.

Enkianthus is a genus of erect, distinctive and graceful garden shrubs. With their deciduous foliage and whorled branches, the various species resemble some azaleas. The vivid, usually red autumn coloring of the foliage is a special decorative feature. The following species have proven dependably hardy in the greater New York area and are fine companions among rhododendrons and evergreen and deciduous azaleas. All of the plants mentioned have racemes of pendulous urn-shaped flowers which are produced in May. They do best in moist, peaty soil. Enkianthus do not thrive in heavy shade and should be treated much like deciduous azaleas.

E. campanulatus is the Japanese species most readily available. Its ultimate height is 25 feet. It has graceful clusters of flowers varying in color from pale yellow with dark red striations to completely dark red flowers in the variety *palibinii.* Another variety, *albiflorus,* has pure white flowers.

E. cernuus, another Japanese species, but not often available, is of a smaller overall structure than the preceding. It may reach 10 feet, and produces racemes of small white flowers which are distinguished by the fringed mouth of the bell-shaped corolla. The variety *rubens* has rich, deep red flowers and brilliant autumn foliage.

E. perulatus is an attractive, even smaller shrub commonly used in Japan for low hedges, which are severely pruned to maintain a compact low border. It is dense, and grows slowly to about 6 feet. Plants have masses of urn-shaped white flowers in spring and excellent autumn color. A dainty and decorative shrub.

Epigaea repens (Mayflower or Trailing-arbutus), native to eastern North America, is a prostrate evergreen shrublet with creeping stems bearing fragrant, white-to-pink flowers in early spring. Establishing small collected plants from the wild is not always easy, but well established seedlings or cuttings from pots are successful in the garden if given the basic requirements of an acid, peaty, damp situation (rotted hemlock or pine needles help) in the full shade of shrubs or trees. A winter mulch of pine needles or hemlock branches is an excellent precaution against desiccation.

Erica (Heath). See p. 58.

Gaultheria is a large widespread genus of more than 100 species native to North and South America, East and South Asia, and Australia. Among these there is only one that can be unconditionally recommended for the greater New York area, for none of the others, including the Japanese species, have proven dependable here with ordinary care.

G. procumbens (Wintergreen) is widely distributed in eastern North America as well as in some areas in the center of the Continent. It is a spreading evergreen

Spike-heath (*Bruckenthalia spiculifolia*) is an accommodating evergreen, spreading and low, suitable for rock or heather gardens or foreground of other shrubs.

Trailing-arbutus (*Epigaea repens*) is an attractive ground-hugging evergreen.

shrublet forming carpets of glossy dark green foliage, with white-to-pink solitary nodding flower bells in spring. In winter the leaves take on shades of bronze and red, and scarlet fruit is borne. It is one of the most useful decorative groundcovers, particularly in borders for larger ericaceous plantings.

Gaylussacia. There are about 50 species (deciduous and evergreen) in North and South America, including the edible huckleberries. The most ornamental and useful species for the Northeast is *G. brachycera* (box huckleberry). See p. 83.

Kalmia. This valuable genus has six species in North America, most of them hardy and very ornamental. The best known is the showy *K. latifolia* (mountain-laurel or calico-bush), common in the Northeast and most adaptable to average woodland conditions, but flowering more profusely in full sun. Although rather slow in growth, fine large specimens are often seen, occasionally to 20 feet or more. The heights are much less under garden conditions. The glossy evergreen foliage, which resembles that of some rhododendrons, provides a fine background for the clusters of almost white (no true white seems to have been recorded) to deep pink flowers which open in June. It is one of the most beautiful American shrubs. (See page 44.)

Kalmia angustifolia (sheep-laurel or lamb-kill), with dull, olive-green leaves, is the next most common and useful species. It is a common wilding in the eastern United States and Canada, and spreads to other areas occasionally. The species is variable, plants ranging from dwarfs of about 6 inches to shrubs 3 feet tall. The purple flowers in late spring are in congested terminal clusters on the previous year's growth and are often hidden by the new growth. There are also selected color forms—*rubra* with deep purple-red flowers, and *candida* with pure white flowers. Closely allied species: *K. carolina*, similar in growth habit, to 18 inches, and with smaller gray, downy, narrow leaves. Native from Virginia to South Carolina.

Kalmia polifolia (*glauca*) is a low, straggling shrub to about 2 feet in height, but not usually that tall in bogs, where it is common. It has a wide distribution in North America. The purple flowers, which are in open terminal clusters, appear in spring and early summer. The narrow, bright green leaves are glaucous beneath. Var. *microphylla* is a tidy dwarf not over 6 inches tall. It has small oval leaves and wiry stems bearing typical pink, saucer-shaped flowers with crinkled edges. This variety is prostrate and mat-forming, and native to the colder regions of western America. In the East, it is a difficult plant to maintain and a further challenge to bring into flower.

Kalmiopsis leachiana is a most attractive small evergreen shrub from Oregon, where it was first discovered in 1930. Its height is about 1 foot. It is the only species in the genus and is intermediate between *Kalmia* and *Rhododendron*. In more recent years another colony was located in Oregon along the Umpqua River and plants from this area are referred to as Le Piniec or Umpqua form. It appears to be a more tractable plant than the original introduction, but still is not easily grown or long-lived outdoors in the eastern United States. It is best cultivated as a pot plant and maintained in a coldframe over winter. In May to June it produces kalmia-like rose-purple flowers that resemble small saucers. The species seems to require damp but well-drained humus or peat soil. A western or northwestern exposure away from morning sun should be advantageous.

Ledum. This small genus contains several species of low-growing evergreen shrubs of swampy moors of the northern latitudes. They have distinctive foliage and clusters of white flowers.

L. groenlandicum (Labrador-tea) is the best known of the genus. Height: to 3 ft. The flowers are borne from May to June in conspicuous terminal clusters. The species is widespread over colder areas of North America and is extremely hardy. Its height is about 3 feet, but variety *compactum* is a dense, neat shrub to 1 ft.

Leiophyllum buxifolium (Sand-myrtle). See p. 83.

Leucothoe. There are about 35 species spread widely throughout the world, but only a few are worthy of garden use. (Pronunciation: lu-co-tho-ee).

L. fontanesiana (previously *L. catesbaei*) is an evergreen shrub from the southeastern United States, but hardy in the North. It may reach 6 feet in height. The plant has arching branches and glossy foliage, which turns purplish in cold weather. Fragrant, white, lily-of-the-valley-like flowers are borne in short racemes along the branches in April and May. Its wide spreading and tall growth requires careful use in landscaping in order to permit its maximum development. The form 'Nana' is said to grow to about half the height of the typical species.

L. axillaris is a similar species, also from the southeastern U.S., but being from lowlands may not be as hardy as *L. fontanesiana.* Its height is 3-4 feet at most.

L. keiskei is the jewel of the genus, a small plant from Japan with the largest cylindrical white flowers, in terminal racemes in July. It is rarely over a foot tall. The almost prostrate branches have a zig-zag growth habit and the glossy evergreen foliage turns to deep crimson tones in autumn. It should be planted in peaty soil which does not become dry. Provide considerable shade for it from overhanging evergreen shrubs.

Labrador-tea *(Ledum groenlandicum)* is a low-growing shrub with white flowers.

L. davisiae is a beautiful species from the western U.S., which is not hardy in the Northeast.

Loiseleuria procumbens, a mat-forming shrub native to far northern areas around the globe resembles a tiny creeping azalea. It is a difficult plant to establish, neither growing well where summers are warm nor flowering freely in cultivation. A great challenge to the avid plantsman.

Menziesia. Although this genus is represented in North America and East Asia, only the species from Japan are especially decorative. They are relatively slow growing, small deciduous shrubs which have been overlooked by many keen nurserymen.

M. ciliicalyx is a small deciduous shrub—2 to 3 feet high, much branched and with oval, slightly hairy leaves. In May and June, nodding flowers appear in clusters at the terminal points of the previous year's growth. The ½-inch-long

The white bell-shaped flowers of leucothoe *(L. fontanesiana)* catch the sunshine in a woodland garden.

flowers are urn-shaped and vary in color from pale yellow to soft pink and red.

M. purpurea is a similar, larger-growing Japanese shrub, but with deeper purplish-pink or rose bell-shaped flowers.

Oxydendrum arboreum* *(Sorrel-tree, Sourwood) is a beautiful deciduous tree native to the southeastern United States, where it sometimes grows to 60-70 ft. It may be grown as a multiple-stemmed shrub or trained into a single trunk tree. Oxydendrum is an ideal plant among azaleas and rhododendrons, requiring the same cultural conditions. The white flowers in slender racemes appear in July and August, and the attractive drooping fruit stalks are retained into autumn. An added feature of this too seldom planted native tree is the exquisite crimson leaf color in autumn. It is of interest that this species, which is the only one in the genus, is the only ericaceous tree hardy in the northeastern United States.

Phyllodoce is a genus of dainty evergreen heath-like shrubs, doing best in peaty, cool, moist conditions. They bear clusters of urn-shaped white, cream, pink or purple flowers. All the species are from subarctic regions of the Northern Hemisphere and do not grow well in the heat of more southern climates. Among the several species is the outstanding evergreen *P. nipponica* from Japan. It has terminal umbels of tiny bell-shaped white flowers. Not an easy plant to maintain.

Pieris. See p. 88.

Tripetaleia is a genus of two species, both small deciduous shrubs. They are seldom available from nurseries but are of interest to the keen collector.

T. bracteata is a species from the mountains of northern Japan. It is compact, slow growing and really not very conspicuous even in bloom, for the flowers, which appear in summer, are small and greenish-white. This little shrub has a spreading habit of growth and may reach 8 inches in height.

T. paniculata is an erect, well branched shrub which may attain 4 feet. The flowers are white, tinged pink, with narrow petals, in panicles and produced in July and August. It is also a mountain plant, but more widely distributed through the Japanese islands than the previous species.

Tsusiophyllum tanakae is a rare shrublet from Japan. It is slow growing and spreading in habit and may attain a height of 16 inches after many years, but with a broader diameter. The plant is multibranched and has ⅛-inch-long, oval, pointed and hairy leaves. They are deep green and partially deciduous. The species produces many small, white, five-petalled tubular flowers in pairs in June and July. This choice, delightful gem from the mountains of central Japan does best in part shade and is distinctly hardy, never having suffered any damage in my garden in the more than 20 years I have grown it. In recent years Japanese botanists have reclassified this plant and it is now known as *Rhododendron tsusiophyllum.*

Vaccinium. A genus of about 130 species. It includes both deciduous and evergreen species, which range from low ground covers to shrubs 10 feet tall. Unfortunately, few of the handsome evergreen kinds are hardy in the northeastern United States. The hardy deciduous blueberries are useful in the large garden.

V. angustifolium (*pennsylvanicum*), the low-bush blueberry, is a very hardy, low growing deciduous shrub with a wide distribution in the northern part of the U.S. and Canada. Occasionally grown for its fruit. It can also be utilized as a ground cover in the open woodland garden.

V. corymbosum (high-bush blueberry) is a well known species which has many named varieties cultivated for their edible fruit. It may grow to 10 feet, and is a beautiful shrub both in flower and fruit. The autumn foliage is brilliant. (There are many other American species producing blueberries as well as cranberries, deerberries, bilberries and whortleberries.)

V. vitis-idaea (cowberry) is a circumpolar evergreen species of varying height. The upright form is about 9 inches tall, and makes a spreading mat by underground rooting stolons. It is sometimes used as a ground cover. The wiry arching stems support oval, glossy, dark green foliage, and in May and June there are white or pink urn-shaped flowers. The decorative dark red fruit—up to ½-inch across—is generally produced when the plant is fully exposed to the sun and grown in moist, peaty soil.

Vaccinium vitis-idaea var. *minus,* sometimes called mountain cranberry, is even a more useful plant than the species. It is low and creeping, just a few inches tall, and creates an excellent ground cover. The dense growth and handsome shiny evergreen foliage is most attractive with its metallic mahogany tones in winter. The fruit is a valuable "crop" for jellies and preserves. An alpine lawn with *V. v-i.minus* predominating is a beautiful garden feature.

The sorrel-tree (*Oxydendrum arboreum*).

Zenobia pulverulenta grows wild in coastal plains from North Carolina to Florida. It is a decorative small shrub which can eventually reach 6 feet, at which height it may have a spreading and less rigid habit than in youth. The most striking ones have distinctive grayish-blue leaves, which are oval. There is also a green-leaved form, which is less attractive. In late May or June this species has large, glistening white, cup-shaped flowers in clusters that droop from the terminal points of the preceding year's growth. Hardiness seems to vary, and the plants I have tried in my garden have not been tolerant of winter cold, but zenobia has grown for many years at the Arnold Arboretum near Boston, Massachusetts. ◆

The gardener's hands are not necessarily tied in affecting winter hardiness of rhododendrons

COLD HARDINESS IN RHODODENDRONS

Gustav A. L. Mehlquist

TO many people hardness in plants means simply the survival or reasonable success of a particular plant in a given situation. Though these objectives may satisfy the connoisseur as well as the plant breeder, both know that the survival or success of a particular variety is dependent on a number of factors, some of which are under the control of the grower.

In general it can be said that hardiness is induced by factors which tend to reduce the growth of the plants. The most important of these factors are undoubtedly low temperature and short photoperiod (day length). Temperatures low enough to slow down active growth, but not low enough to injure the tissues, tend to cause a decrease in visible growth and a general hardening of all above-ground tissues. Short photoperiod tends to have the same effect, although plants vary a great deal more in their response to photoperiod than to temperature.

It has been shown that these factors influence growth, and thus hardiness, independently, but under natural conditions they tend to work together. Though subject to rather wide seasonal variations, the temperature may also vary markedly from below to above normal on any one day or from year to year, and the photoperiod may vary according to whether the weather is clear or cloudy. Those who might argue that the day length is one of the few features which remain constant from year to year should bear in mind that many plants which respond to photoperiod, or variation in day length, are so sensitive that they are even influenced by part of the twilight. This means that the effective daylight period on clear days is about one hour longer than the period between sunup and sunset, whereas on cloudy days there is little or no twilight, making the effective daylight period correspond more closely to the period between sunup and sundown.

Many other factors will reduce the top growth of the plants. Low water supply in the soil is very effective especially if accompanied by fairly high temperatures. High temperatures cause water to evaporate more rapidly from the soil and also to be lost in greater quantity through transpiration, which generally increases with higher temperatures. Rhododendrons should not be allowed to become too dry at any time, but a gradual reduction in watering toward the end of the active growing season might be beneficial.

In many plants a high concentration of salts in the soil may cause a reduction in growth, but since rhododendrons generally are sensitive to high salt levels, heavy fertilization of these plants is generally not practiced, at least not by the skilled grower. Of course, in some areas of this country the soil is naturally high in soluble salts, but in such areas the soil would need special treatment to make the growing of rhododendrons practical anyway.

It is well known that different species and hybrids may vary a great deal in their ability to withstand low temperatures, not only among themselves but also from season to season. Before one speculates further on this fact, one might consider the nature of cold injury. It is generally agreed that, although many of the finer points regarding cold injury are not understood, the damage from freezing temperatures can result from two conditions: ice formation in the cells, which irreparably damages the protoplasm, eventually causing death; or dehydration of the tissues. Rhododendrons and other broad-leaved evergreens are subject to considerable water loss throughout the year, especially in windy situations. It is thus important to aid the plants to obtain sufficient water to sustain this water loss. One way is to place the plants in a situation where the wind is not likely to be excessive. Another is to put up screens of some sort on the windward side in order to lessen the effect of the wind.

A far better way, however, is to prevent the ground from freezing too deeply by the use of a mulch of some sort. When sufficient snow comes before the ground freezes to much of a depth, there is usually much less damage from dehydration than when the ground freezes deeply early in the winter. Since early or even sustained snow cannot be counted on in many regions, it is very important to keep the plants well mulched during the winter with leaves or some material having a similar effect in preventing winter injury, especially from dehydration.

Short distances often make a great difference in whether plants will suffer winter damage or not. A hill or an evergreen woodland may cut down the wind and consequent dehydration. Planting near a building may have the same effect to an even greater degree, for here the plants will be shielded from the wind, at least from certain directions, and in addition the soil is less likely to freeze so deeply, especially if the building is heated. The different so-called microclimates usually found in most gardens are caused by these varying physical features of the site. Furthermore, these microclimates evolve with time. The old saying "a garden comes with age" is literally true, for as the plants grow bigger, they not only furnish more protection for one another but also they permit under-planting of smaller and more tender varieties.

That different rhododendron species and hybrids differ in their tolerance to frost, wind, heat, drought and other factors which affect growth, are truths which every novice learns quickly. It takes him longer to learn what varieties to select and how to place them so as to utilize as fully as possible the natural and artificial features of his garden site, and at the same time to achieve the landscape effect that is desired.

It is well known that the form, size, shape and other outward features of a plant as well as such physiological variations as frost tolerance, season of flowering, disease resistance and ease of propagation are all factors that are ordinarily genetically controlled. Although various cultural practices will modify the effect of genetic differences, it is much easier to start and succeed with a genetically suitable variety than with a variety which is not.

Basics of Plant Breeding

The plant breeder must learn as much as possible about the inheritance of the various traits of the plants he is interested in and about the various species and hybrids in which the desired traits exist. He may still be unable to produce the desired combination of desirable features he seeks, but certainly his chances of success are greater when he has a thorough knowledge of all aspects of the plants with which he is working.

The gardener may find it neither possible nor desirable to go so deeply into the background of the plants he purchases, but to give some consideration to their potentials—and the various means by which they may be realized—is simply good sense. Much of this information is often available from the nurseryman who sells the plants; more information may be available from books, periodicals and horticultural societies. There are also friends, whose gardens may represent practical demonstrations of what might be good or bad! In any case, it is well to keep in mind a few basic facts concerning hardiness.

With the advent of lower temperatures and shorter days toward the end of the summer or beginning of the fall, visible top growth begins to decrease and gradually ceases altogether. This process is greatly hastened if water and nutrients are on the low side. As growth decreases, there is a gradual accumulation of carbohydrates, as they are no longer used up in the formation of new tissues. At the same time, there is an accumulation of certain enzymes which gradually convert the insoluble carbohydrates into soluble sugars. These sugars accumulate in the vacuoles; this leads to dehydration of the protoplasm, causing a change in the proteins characterized by a tighter binding of the remaining water.

When maximum binding of the water has taken place, the cells and tissues possess maximum frost resistance. Genetic differences determine the rate and extent to which this process takes place. Thus some plants have greater genetic potential for developing hardiness than others.

In late winter or early spring a reverse change in enzyme activity or content occurs. Sugars are reconverted to starch, the vacuole concentration decreases and the protoplasm increases in water content, resulting in a gradual release of bound water from the proteins. With the gradual accumulation of starch from the reconverted sugars, the plant loses its hardiness to frost and will in fact resume growth as soon as weather conditions permit.

The Chilling Factor

During the interval between the time the plants have become dormant and until they are ready to resume growth again, relatively low temperatures are not only endured but actually required by most plants adapted to a temperate climate. Hence this period is often referred to as the *chilling requirement*. It was formerly thought that the lower the temperature the faster the chilling requirement would be satisfied. Now it is known that temperatures between 35°F and 45°F are quite satisfactory. The length of the chilling requirement varies greatly with different species and cultivars and is ordinarily genetically controlled. Generally the length of the chilling requirement in a wild species corresponds to the duration of low temperatures during which active growth is either restricted or might result in severe damage. Therefore, species which come from areas where the low temperature season is short may be severely injured when transferred to areas where low temperatures may extend well beyond the time at which the chilling requirement is satisfied. Many of the Asiatic rhododendrons and azaleas are often injured in New England after a spell of "nice" weather in late winter or early spring when lower temperatures are encountered again. But such species as *Rhododendron catawbiense* or *R. maximum* are seldom injured because they remain dormant until the chances of damaging temperatures are not so likely. Hybrids, in their chilling requirement, tend to be intermediate although there are many exceptions. Many hybrids can be injured because of distinct hybrid vigor—reflected in late growth which fails to mature properly before the onset of freezing temperatures. Azaleas and rhododendrons, which do not produce more than one flush of growth per season and mature well in advance of freezing temperatures, are much more likely to withstand severe winters than those which continue late growth. If, in addition to stopping growth early they also remain dormant until rather late in spring, they stand a good chance of surviving. Not that a plant merely by being dormant will withstand any temperature. *R. catawbiense,* when thoroughly dormant, has been known to endure more than —30°F, whereas it is unlikely that *R. wardii*—even if equally dormant—would stand much below 0°F; but in general, there seems to be a correlation between long dormancy requirement and ability to withstand low temperatures.

It should also be understood that a plant may possess hardy foliage and wood and yet lose most of its flower buds during cold weather; sometimes the reverse is true. In my garden I have had seedlings on which the leaves invariably were disfigured from wind and low temperatures to the extent that the plants were worthless as ornamentals, while most of the flower buds were uninjured.

Since the garden value of rhododendrons depends on the foliage alone for at least several months of the year, breeders must consider the quality of the foliage as much as the flowers.

So-called hardiness ratings are not necessarily a true index of hardiness, especially in a region far removed from the one in which the ratings were made. Establishing reliable hardiness ratings is time consuming and, since realistic ratings must be based on the duration of the cold weather as well as the actual temperatures, it follows that ratings established in one area of the country may not be reliable in another.

In my garden R. 'Vulcan,' which has a rating of H3, has consistently proved itself hardier than R. 'Mars' which has a rating of H2. Actually two plants of R. 'Vulcan' and their cutting progeny have proved hardier than a third and its cutting progény. This may be due to the fact that 'Vulcan' is reported to be a group name and that the three plants in my garden represent two, possibly three, different clones.

Although it is convenient to define growth as *visible increase in size* only, in discussing hardiness it is not necessarily a true picture of what goes on in the plant. Growth, if defined as an *increase in dry matter,* goes on well beyond the time at which visible growth stops in the fall and may begin long before visible growth begins in the spring. It is for this reason that fertilizer applications are often made with good results *after visible growth has ceased but before the ground freezes.* The soil often remains in good condition for active root growth and fertilizer absorbtion and utilization several weeks after all visible top growth has ceased, and again for some time before visible growth begins in the spring.

For Hardier Rhododendrons

The following points regarding hardiness might be emphasized: Select clones and seedlings best adapted to the area, at least until the garden is old enough to provide protection for more tender varieties. (Information relative to adaptability is usually available from the nearest chapter of the American Rhododendron Society.)

Place each variety where it is most likely to succeed. Varieties of doubtful hardiness should be planted in spring only. All plants will benefit from a mulch of leaves or other organic matter. The mulch will serve to keep the soil of more even temperature and conserve moisture. Care should be exercised not to encourage late growth. If possible the plants should be limited to one flush of growth per season. (Nurserymen will disagree with this advice saying they must have at least two flushes per season in order to produce large enough plants at a seasonable price, but their objectives are different from those of the gardener.)

Make sure there is enough moisture in the ground before it freezes.

Mulch with leaves, 6 to 12 inches deep, before the ground freezes to keep the soil from freezing too deep or too fast. The leaves should not be removed in the spring unless the plants are small and there is danger of smothering them.

If fertilizers are needed they may be put on on top of the mulch. They will then gradually filter down to the roots and help to break down the mulch as warmer weather comes in the spring. Large-leaved varieties may need some wind protection in the form of evergreen branches or screens of some type. Varieties with distinct indumentum on the lower surfaces of the leaves are considered more resistant to winds and breeders are now hard at work developing such varieties.

The old flowers should be removed as soon as they become unsightly to prevent their setting seed. Many varieties tend to be alternate flowering if allowed to set seed.

It goes without saying that timely and sensible insect and disease control will greatly enhance the likelihood of success, as damage from either insects or diseases is likely to lessen the beauty and vitality of the plants and perhaps even their hardiness. ◆

NEW HYBRIDS FROM LONG ISLAND

Doris M. Stone

EVERY rhododendron hybridizer has an objective. Mr. Howard Phipps had as his major goal the production of hybrids which would be hardy enough for the Long Island winters and yet free from the "muddy" pigments so common in the older "ironclad" rhododendrons.

Mr. Phipps has been eminently successful in reaching his objective for today his best hybrids have true vibrant colors, especially his red clones.

Mr. Phipps started his rhododendron project in 1909 with 1,000 shrubs imported from England by the Kelsey Nursery Company. Most of those plants were "ironclads," and some can be seen today along the drive and in front of his house in Old Westbury. During 1939, when war had cut off the supply of hybrid rhododendrons from England, Mr. Phipps visited the Dexter nursery at Sandwich on Cape Cod where he acquired several hundred more plants. Among them were some of the best of Charles O. Dexter's seedlings. Subsequently, many of these were named by a group of rhododendron experts who, in their search for the finest of the Dexter originals in various gardens, visited the Phipps estate in 1952.

In 1951, Mr. Phipps visited the Rothschild estate in England and obtained a good collection of the hardier varieties of the famous Exbury rhododendrons. Several years later Mr. Phipps obtained from P. H. Brydon on the West Coast *Rhododendron yakusimanum*. By this time the Phipps rhododendron hybridizing project was firmly established and has continued ever since. The garden of Mr. Phipps now contains thousands of hybrids; pedigrees of most of these are known, precise records having been kept since 1952. Although the Dexter rhododendrons formed the nucleus of the breeding stock, the following parents have afforded great success:

'Mrs. Furnival'—pink, blotched with crimson
'Naomi'—pink, fragrant
'Avocet'—white, fragrant
'Britannia'—scarlet
and the species *R. decorum, discolor* and *fortunei.*

During the past five years, rhododendron pollen from H. L. Larson in Tacoma, Washington, has been used with apparent success. The use of lights to induce early blooming is another recent innovation. Under this improvement, some seedlings have bloomed at the age of three and one-half years.

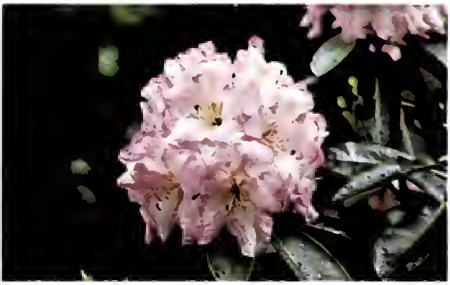
For many years, the Phipps hybrids have been regular prize winners at the American Rhododendron Society shows on Long Island. In 1971, three of these plants were registered with the American Rhododendron Society Plant Registry: 'Ananouri'—red funnel-shaped flowers, plant of semi-dwarf habit; 'Erchless'—pale pink, deep funnel-shaped flowers with a maroon, almost black, blotch in the center, vigorous plant habit; 'Mrs. Howard Phipps'—deep pink funnel-shaped flowers, compact plant habit.

Mr. Phipps has not confined his horticultural interest to rhododendrons, although it is with these that he has been most successful. Before the war he was a hybridizer of peonies, but this project came to an end when their roots were attacked by nematodes and their copper labels were stolen. Similarly, bad luck terminated a breeding project with hibiscus which Mr. Phipps conducted in his Florida garden. A hurricane caused flooding of the plants and by the end of two weeks nearly all of them were dead. His first love, however, was rhododendrons, and to those he turned his undivided attention in 1951. One hopes that eventually the achievements of his life-long work will be available to all rhododendron lovers. ◆

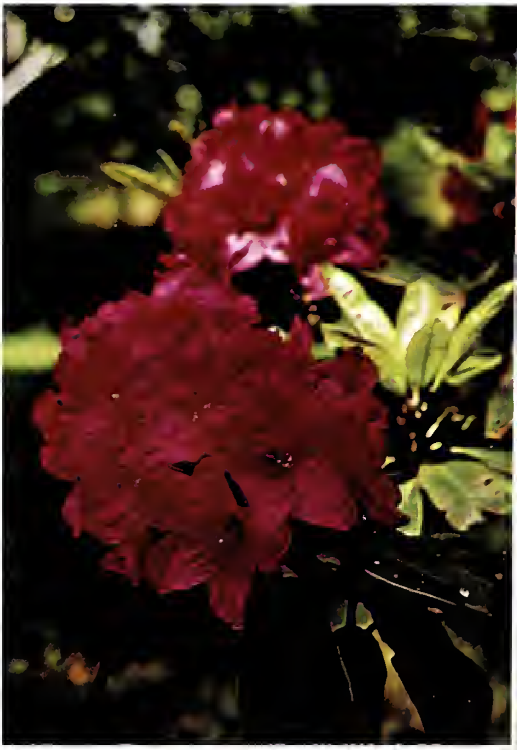
Rhododendron Hybrids from Mr. Howard Phipps

The Phipps hybrids have been consistent winners at the American Rhododendron Society shows on Long Island. Three hybrids are registered with the Society; others are scheduled for registration. Breeding parents have included Dexter and other hybrids and *R. fortunei, decorum* and *discolor.*

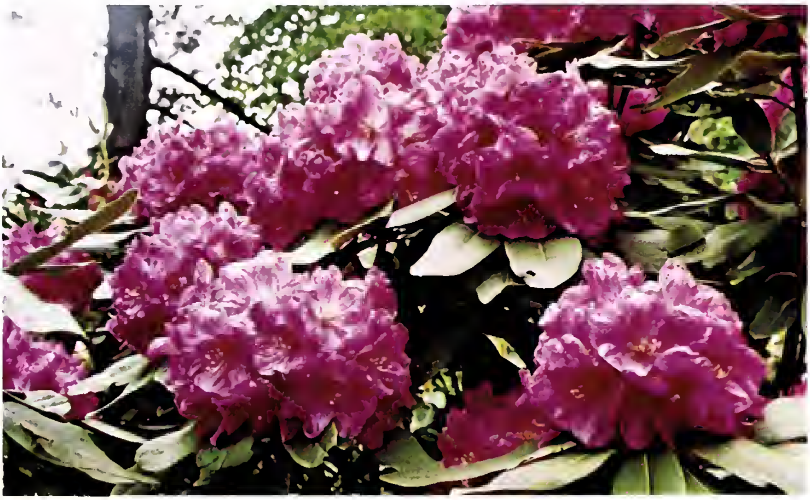
Doris M. Stone

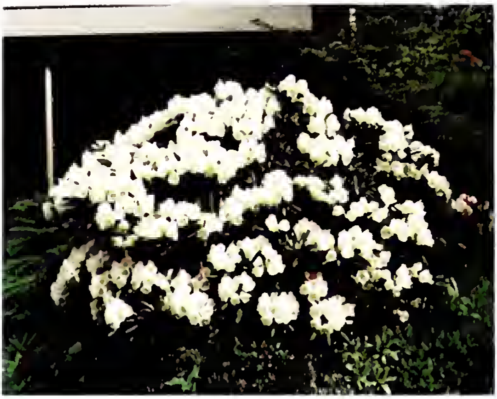


Above: 'Pinkie Price,' a light pink. *Below:* 'Mrs. Howard Phipps' has deep pink flowers in a compact truss.



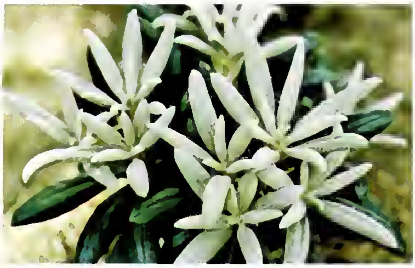
Above: A scarlet hybrid, H. P. No. 39, a cross between the white 'Boule de Neige' and rosy-lilac 'Everestianum.'



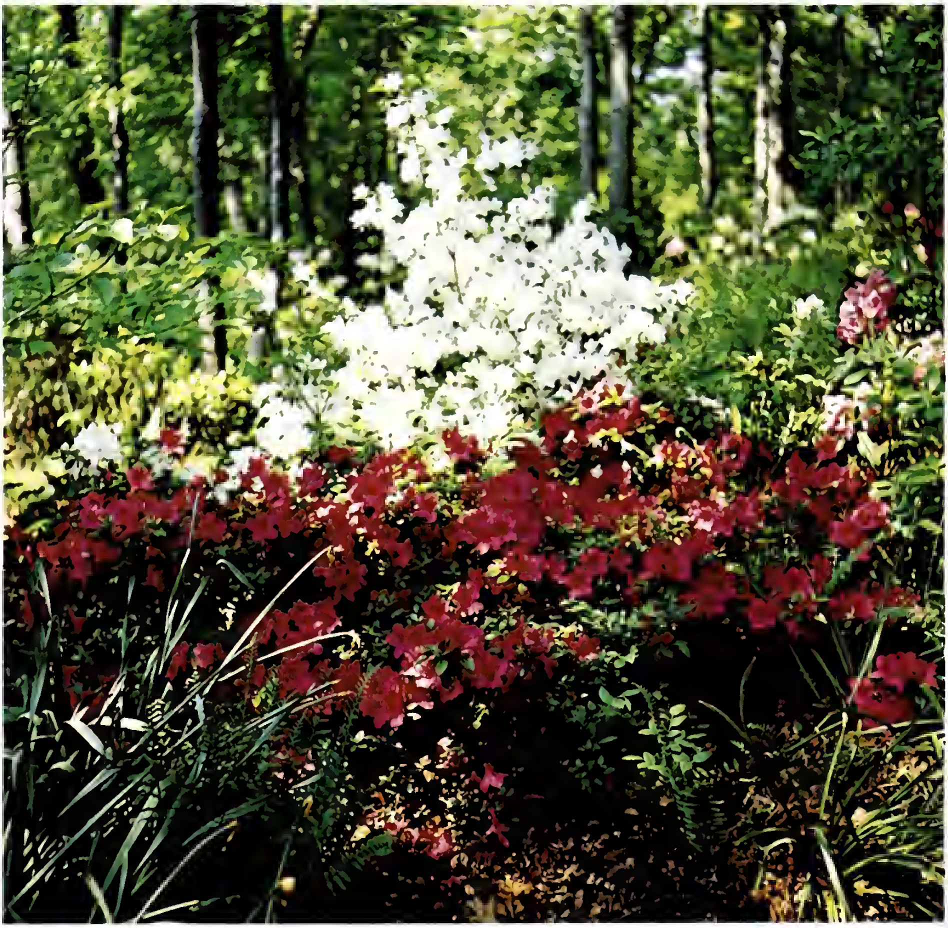


Rhododendron yakusimanum displays its form in a Pacific Northwest garden.

Cecil Smith



The felt-like gray coating on new growth of *R. yakusimanum*.



Azaleas 'Buccaneer' and white-flowered 'Palestrina' enliven a Long Island woodland garden in late spring. 'Buccaneer' is a Glenn Dale hybrid.

Marjorie J. Dietz

AN EXCEPTIONAL DWARF RHODODENDRON

Rhododendron yakusimanum is considered by many to be the most beautiful species of the genus

A. Frederick Serbin, M.D.

RHODODENDRON yakusimanum is probably a primitive species almost extinct today—for it is to be found only on the peaks of three mountains on the tiny island of Yaku Shima. The island, 15 miles in diameter, is one of the world's great rain forests with 400 inches of rain at mountain-top level. It lies 120 miles south of the lowest part of the Japanese mainland in the sub-tropical, typhoon-swept China Sea not far from Iwo Jima. Collecting plants here is forbidden since the island has been declared a national shrine.

The species, first described by the Japanese botanist T. Nakai in 1920, was introduced into the western world when K. Wada sent two seedling plants to Lionel de Rothschild at Exbury, England. Both of these plants grew luxuriantly in the favored climate of southern England. One plant, an exquisite specimen, made its way to the Wisley Garden and when first exhibited at the Chelsea show in London in 1947 caused a sensation. It was at once awarded the highly prized First Class Certificate. The second plant, known as the "Exbury Form," equally as beautiful although different in habit of growth as well as in foliage, was not exhibited until a year or two later. Had it been displayed earlier it would certainly have received the F.C.C. award.

Although many variations of the species occur from seeds collected in the wild, with very few exceptions, the flowers are constant in color and form. In the mature plant there is a flower truss at the tip of almost all stems. The buds open at first coral pink, then as the bell-shaped florets expand fully become a cluster of five-six lobed white flowers 2½ inches in diameter. The flowers open at varying periods so that at one time pink and white color is seen giving the effect of apple blossoms. *R. yakusimanum* is a densely foliaged dwarf rhododendron, rarely attaining a height of more than 2 feet after 15 years in New England. Unlike most rhododendron hybrids and species which maintain their foliage for an average of two years, it can hold its leaves for five to seven years, creating dense green hemispheres. The new growth is as charming as the flowers. The new shoots, which make their appearance as the flowers fade, are white and woolly with soft velvety indumentum on both surfaces of the leaf. Touching the young leaves and stems gives the feel of soft suede. As the new leaves mature the top surface takes on a dark shiny green and the undersurface a permanent beige-brown dense indumentum. The heavy leaf itself is frequently curved longitudinally as well as transversely.

In England the species is propagated either from seed or grafted on *R. ponticum*. In the U.S., favored forms are usually propagated from cuttings. The species roots from cuttings with some difficulty; the successful percentage of rooting is rather low in the Exbury form and somewhat better with the F.C.C. form. The variations from seed are exciting. Seeds germinate most readily in about ten-fourteen days under optimum conditions. After two years of growth, plants reach about 2 inches in height and considerably larger when grown under lights. In five years most seedlings are about 4 inches by 4 inches and frequently multi-branched. Variations from seed occur even when flowers have been carefully selfed, covered and well protected from bees and wind. Most plants including the Exbury and F.C.C. forms have leaves 3 to 4 inches in length. However, some plants have heavily veined leaves 6 to 8 inches in length and some dwarf forms (not yet described) have leaves ¾ to 1½ inches in length. Some of the large-leaved forms produce much larger florets which are frequently fringed. Occasionally, one finds a seedling which remains pink when fully opened. The author considers the Exbury form the finest of the species.

R. yakusimanum has been vigorously adopted as a parent plant in hybridizing by the rhododendron buff. Shortly after the species had been introduced it became apparent that in crossing with other rhododendrons it had the tendency to produce dwarf offspring. Moreover, hybrid seedlings took on increased density in foliage. Unfortunately the author has yet to see a primary cross that is better or even equal to its "yak" parent. All members of this species are hardy and capable of surviving to −20 to −25 degrees below zero without snow coverage. However, its flower buds will blast at sustained sub-zero temperatures exceeding thirty-six to forty-eight hours. Its greatest shortcoming is that it is not heat tolerant. For this reason, it is rarely seen in most Japanese gardens where the summers are hot and dry over sustained periods.

Although well established plants can withstand fully exposed areas, they perform best in cool, semi-shaded areas with an eastern or northern exposure. About 50 per cent sun appears to be optimum. If *R. yakusimanum* never flowered, it would still be considered one of the most desirable of dwarf shrubs because of its striking foliage and form. ◆

Rhododendron yakusimanum in full bloom in its native habitat—Japan's island, Yaku Shima in the China Sea. It is 15 miles in diameter and is known for its three rain-soaked mountains, of which the peaks of two appear in the photograph.

Two low-growing members of the heath family

BOX HUCKLEBERRY AND SAND-MYRTLE

Hazel and Don Smith

BOX HUCKLEBERRY (*Gaylussacia brachycera*) and sand-myrtle (*Leiophyllum buxifolium*), two handsome small-leaved evergreen relatives of the rhododendrons and heaths, are being sought today by discerning plantsmen in the northern U.S. Box huckleberry is proving to be an adaptable ground cover, and sand-myrtle is a candidate for the rock garden or may be used as a diminutive accent shrub. Both are rare native plants that have long been unavailable to gardeners, yet they belong to the earliest American plant heritage.

Box huckleberry and sand-myrtle are found wild only in a few parts of eastern North America. Box huckleberry exists in limited areas of Delaware, Pennsylvania, Maryland, Virginia, West Virginia, Kentucky and Tennessee. Sand-myrtle is native to the New Jersey Pine Barrens, coastal regions of the Carolinas, and some higher peaks of the Blue Ridge and Smoky mountain ranges. Studying and growing these two gems have given the authors many happy and rewarding experiences, both with plants and with people.

About ten years ago, Alfred Fordham of the Arnold Arboretum gave us a plant of box huckleberry, and thus began an ever-deepening involvement with this charming year-round beauty. The species was first recorded by botanist André Michaux in the late 1790's, then alternately lost and found by plant hunters over the next 120 years. By 1919 it was thought to be nearly extinct.

Our own adventures with the box huckleberry started when we learned it was not available in any nursery. In an old publication we read about the amazing box huckleberry colony in the Amity Hall area of central Pennsylvania—a stand believed by many to have started as a seedling over 12,000 years ago, and which has a claim to being the oldest living thing in the world. Of course, unlike the bristle-cone pines and redwood trees of California, box huckleberry, as a ground cover, is continually renewing itself and none of the current wood dates from antiquity.

From the old article we read, we discovered that the land upon which this venerable colony stood had been owned by a Mrs. Ida Doyle. One day in 1965, on a whim, we decided to telephone her—person-to-person, although we realized the chance of getting her was slight, since, judging from the article, she would likely have been over 100 years old! The call was well worth it, however, for the local operator's reply was: "Mrs. Doyle has been dead for many years, but would you like to talk to a member of her family?" Shortly, we were given permission to collect our first few plants and cuttings of box huckleberry. Of the 20 small rooted pieces, carefully cut from stolons of the parent plant, all lived. And of the 100 cuttings taken, 97 rooted, so we were off to a good start. After five years in containers, they were compact plants 5 inches high and 8 to 15 inches across.

Our second attempt was *not* so successful. Wanting to find plants from another area for cross pollination (box huckleberry, like many huckleberries, is self-sterile), we went to look for the one spot in Maryland where the species is known

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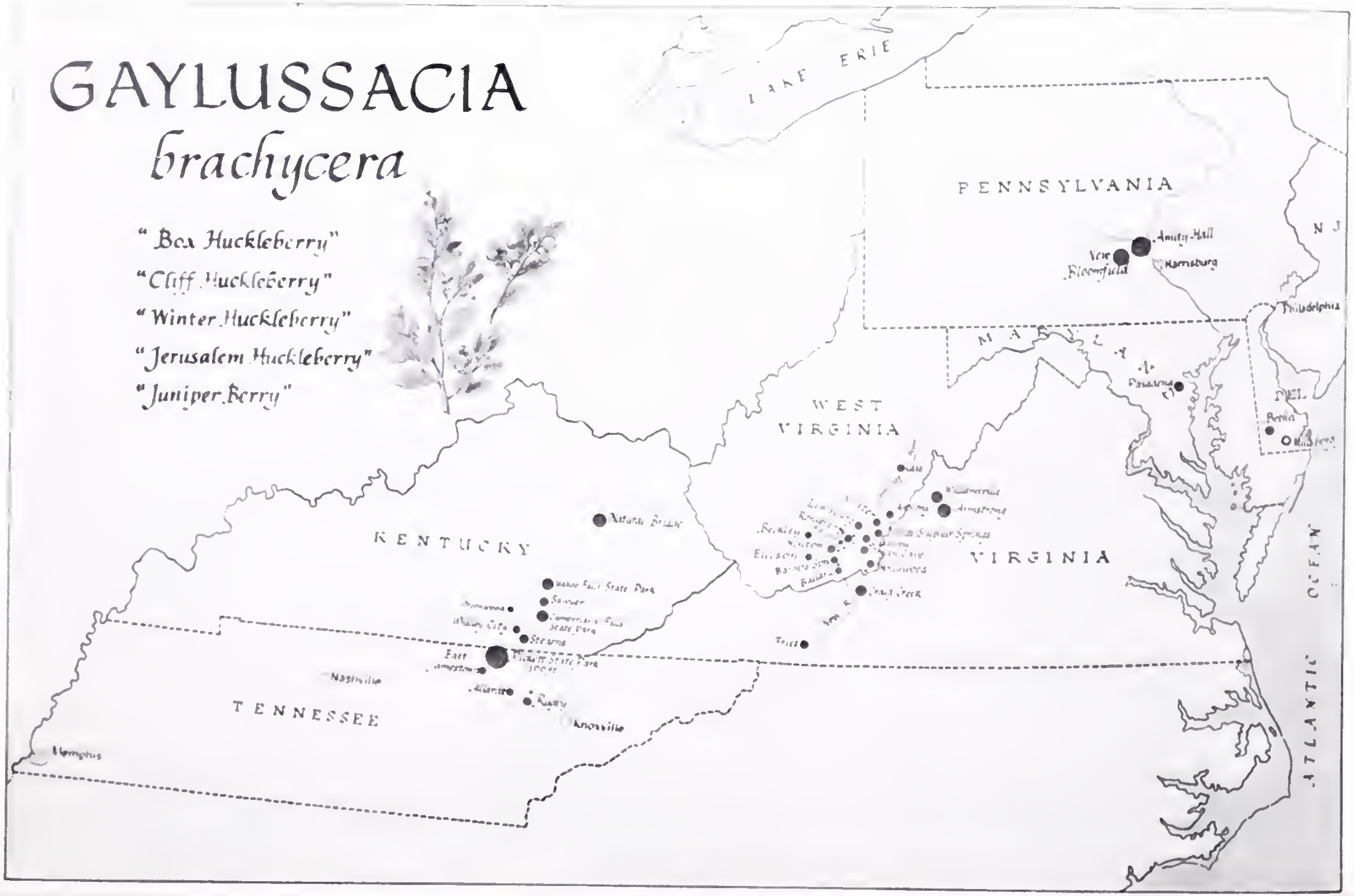
A bibliographical list of box huckleberry references by the Don Smiths appeared in *Castanea*, vol. 36, no. 2 (June 1971), pp. 81-89.


GAYLUSSACIA
brachycera
"Box Huckleberry"
"Cliff Huckleberry"
"Winter Huckleberry"
"Jerusalem Huckleberry"
"Juniper Berry"
LAKE ERIE
PENNSYLVANIA
Amity Hall
New Bloomfield
Harrisburg
N J
Philadelphia
MARYLAND
DEL.
WEST VIRGINIA
VIRGINIA
Armstrong
Sulphur Springs
Beckley
Craig Creek
KENTUCKY
Natural Bridge
Falls State Park
Stearns
Cumberland Falls State Park
Whitley City
Pickett State Park
East Jamestown
Rugby
Knoxville
Nashville
TENNESSEE
Memphis
ATLANTIC OCEAN

to grow. Two state troopers were parked not far from where we thought we should turn off the road and head through the woods. As we showed them a small plant and described the place we wanted to find, they looked very serious. One trooper said: "That area has some pretty mean characters. I wouldn't go there myself." The other was less hesitant and told us how far down the road to go—but didn't offer to accompany us! We came to the run-down area he described, and went into the woods through a long-neglected dump. It was hard going because of catbrier and other tangle. Ten minutes later, we heard shots that sounded not too far away. Soon there were more—and they were closer—but no one was to be heard or seen in the brush. We found our way out of the woods quickly and left for home—without any box huckleberry!

Dr. Edgar T. Wherry, whose interest in rare native plants goes back many years, has encouraged us to search, record and study box huckleberry. We sent pressed specimens from each area that we visited to the herbarium at the National Arboretum. In a special section of our garden we are growing and observing small plants from 35 different colonies in the seven states where box huckleberry is native. These are planted under identical cultural conditions to see if they will retain their differences of coloration, growing characteristics and heights (from 3" to 3' in the wild). This also insures good cross pollination, necessary for the production of viable seed. (Mr. Fordham has shown that the best germination results when this seed is sown as soon as ripe.)

There have been many happy experiences along the way; among them, the thrill of finding 'our first' unrecorded stand of box huckleberry in Tennessee with Dr. A. J. Sharp on an early searching trip, and the friendly response of people everywhere eager to help. We especially remember the enthusiastic, reminiscent smiles of people in their 70's and 80's as they talked of picking the berries as children—and keen to show us where the plants grew. It is interesting to note that today's children knew nothing of the plant or berries!

Treasured friendships have developed, primarily in the mountainous corner of southeast West Virginia where there are many stations of the "juniperberry"—as box huckleberry, because of its light blue fruit, is known locally. Margaret B. Ballard, M.D., who retired from practice and teaching in Baltimore, to her native town of Union, is affectionately known throughout the area as "Dr. Maggie." An active member of the local historical society—and very much interested in all aspects of life in her county of Monroe—she was captivated by the story of the "junipers."

Rev. Fred W. Gray and Dr. Wherry had seen a white-berried form in the vicinity of Hollywood, W. Va. some fifty years ago, and we were eager to see if it was still there. One summer, before meeting Dr. Maggie, we had been directed to a farmhouse, well off the road, where a widow in her 80's lived alone. There, beyond the house, was a particularly nice stand of "juniperberry," but since no one could be roused in the house (although signs pointed to someone being there) we did not feel free to take plants with us. Last autumn we returned with Dr. Maggie, who knew members of the family. We met the elderly lady a mile from her home, walking to the store—some three miles away! She was shy at first, as is the custom of mountaineers, but Dr. Maggie reassured her by talking of people they both knew, and she joined us in the car. How her old eyes sparkled as she told of picking and canning quart-after-quart of both white and blue "juniperberries" in her younger days.

We rode past her house, where the patch originally near it had been scraped away to make room for a new road, and drove through a meadow and up an old dirt road as far as the car could go. There, the widow pointed the way to her 'best spot for the white ones.' She stayed in the car with one of us while the others cut through the undergrowth and found a large patch just where she said it would be, although no berries were to be seen.

D. Estler

Sand-myrtle (*Leiophyllum buxifolium*) is a dainty foliage plant for the rock garden. Clusters of small white flowers are attractive when they cover the plants in May.

We were able to bring home some budded plants and are looking forward to when they produce berries—which we hope will be white.

Our three short years of experience with sand-myrtle (*Leiophyllum buxifolium*) resulted in collecting for our experimental plot, plants varying in form from almost prostrate to upright; in height from 2 inches to 2 feet; and with differences in leaf size, shape and color—all equally beautiful in blossom in May. Because of the great variability in sand-myrtle, it has occasionally been suggested that more than one species may be involved, but the prevailing opinion today is that there is but one, with several botanical varieties.

We've noticed that sand-myrtle needs sun to grow beautifully and, especially, to reproduce in the wild. In a New Jersey Pine Barren field of blueberries that was abandoned ten years ago, there were many sand-myrtle seedlings in the wide, open rows; fewer where sheep-laurel (*Kalmia angustifolia*) and catbrier were coming in; still fewer where some heavy tall grass, inkberry (*Ilex glabra*) and young pines were encroaching; and in the surrounding woods there was no sand-myrtle at all. This was also true on the top of Grandfather Mountain in North Carolina, where seedlings would germinate in rock crevices, even on the cold windswept peak—but always in full sun. In surrounding thickets there were no seedlings, although we found a few growing in sunny openings in the woods.

In gardens, sand-myrtle can be propagated by root cuttings, layering, and cuttings, but in the wild seed is clearly nature's way. Philip E. Marucci, who is Research Specialist in Entomology at the Cranberry and Blueberry Research Laboratory (a division of Rutgers University), took us to the blueberry field where the low form was growing, and later showed us another area. Here, where he had collected large numbers of leafhopper insects 23 years ago, when the area was a sea of sand-myrtle about 2½ feet high, the ecology had changed greatly. Not many of the original sand-myrtle plants were left. Scrub pine, sheep-laurel, inkberry and other undergrowth had crowded them out. The few old plants (one 37 inches high by 4½ feet across), with their beautiful gnarled branches stretching high above the competition, had a mass of seed pods covering their top 5 inches like an umbrella. But there was not a seedling to be found in the now shady field. We brought home a storm-broken branch from one of the plants and were surprised to discover by examining the annual growth rings that it was over 75 years old.

We have moved plants of box huckleberry and sand-myrtle very carefully from the wild. Thoroughly checking these areas later, we found that the parent plants had formed new growth from the roots and so replenished themselves. Another observation we have made is that these two species frequently grow in the wild with some of the same companion plants, yet never together.

Box huckleberry is easy to grow in either sun or shade, needing only the general conditions that make rhododendrons prosper. Sand-myrtle has been a bit more of a challenge for us. It requires at least a half day of sun, and it won't tolerate drought. With care, however, hobbyists have been growing it successfully for a number of years. Both plants benefit from the lack of competition when brought into the garden, and they reward the plantsman generously. (*Nursery sources*: Both plants may be obtained by mail from Mayfair Nurseries, Nichols, N.Y. 13812 or Leslie's Wild Flower Nursery, Methuen, Mass. 01844. The Don Smiths' own Watnong Nursery, Morris Plains, N.J. also has plants, but does not ship. For other sources, see the Brooklyn Botanic Garden Handbook, 1200 TREES AND SHRUBS—WHERE TO BUY THEM.)

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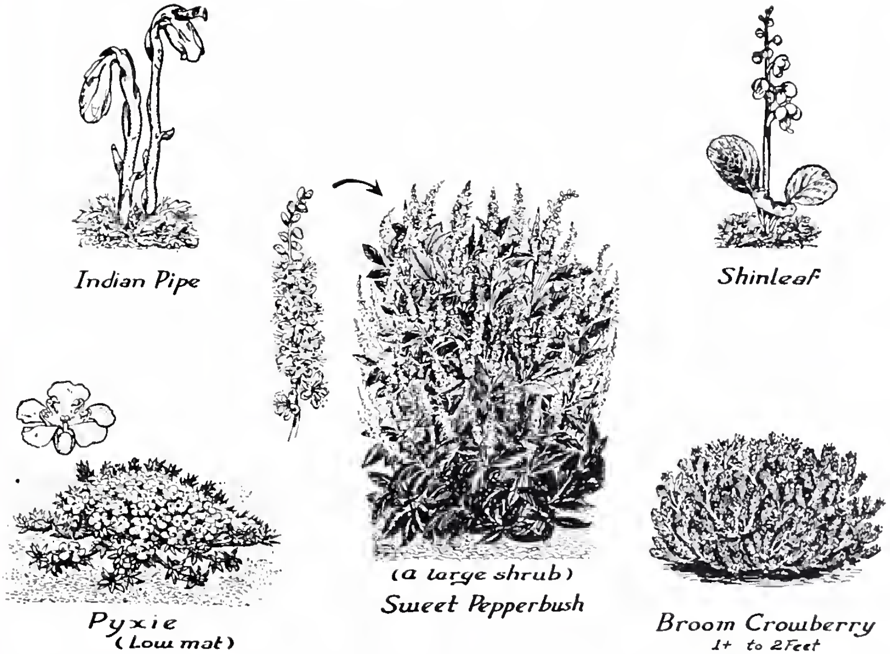

Indian Pipe

Shinleaf

(a large shrub)
Sweet Pepperbush

Pyxie
(Low mat)

Broom Crowberry
1+ to 2 Feet

The plants above are near relations of the Heath family (Ericaceae), and a few have been assigned to it at some time. In the Pyrola family (Pyrolaceae) are Indian-pipe (*Monotropa uniflora*) and shin-leaf (Pyrola); in the Clethra family (Clethraceae), sweet pepperbush (C. *alnifolia*); in the Diapensia family, pyxie (*Pyxidanthera barbulata*); in the Crowberry family (Empetraceae), crowberry (*Empetrum nigrum*). Some botanists also treat *Vaccinium* separately from the Heath family.

Beautiful in flower, form and foliage—the pieris . . .

REMARKABLE AND RELIABLE PIERIS

Joseph A. Witt

PROBABLY the most common ericaceous plants grown in American gardens today, apart from rhododendrons and azaleas, are *Pieris* (pronounced py-ee-ris). Justly so, for some of them rank with the finest broad-leaved evergreens in cultivation. Gardeners often refer to these plants by the common name of "andromeda," which must not be confused with the northern bog plants that botanists place in the true genus *Andromeda* (see page 66).

There are about ten species of *Pieris,* all evergreen. Some are native to the southeastern United States, others to Asia, particularly Japan and China. This seemingly strange geographical distribution of closely related plants occurs in many other genera, *Magnolia* being just one example.

The growth habits of *Pieris* are diverse, too. If one takes a broad view of the genus, it would include a dwarf species, *P. nana,* from the subarctic reaches of northeast Asia. This rare rock garden gem is so distinct from other *Pieris* that it is sometimes placed in a separate genus by itself, *Arcterica* (see page 66). Some *Pieris* from cool-temperate zones are medium-sized shrubs, while others from milder climates are often tree-like, growing to 20 feet or more in the wild. One species, *P. phillyreifolia,* native to northern Florida, Alabama and Georgia, is a vine that may climb to 30 feet or so on bald-cypress (*Taxodium distichum*) trees in a shady swamp, but in northern gardens it is only a dwarf shrub seldom more than 1½ feet tall.

The flowers of pieris are borne in conspicuous terminal clusters. The individual blossoms are small waxen bells hanging from the flowering stems, which may in turn be pendulous or upright, depending on the species. They are white, sometimes light pink. The fruits, which are dry berry-like capsules, provide winter interest, as do the new flower buds that form in autumn. All pieris bloom in early spring, and some may even be called winter-flowering where I live, in Seattle. The bloom period of individual plants is a rather long one.

The pieris plants that one is apt to find in gardens are fairly tolerant of different growing conditions, providing the soil is acid and not waterlogged. An exception is *P. floribunda* which has a reputation of being able to grow in alkaline soils with no problems. All pieris grow best in moderately rich garden loam.

Exposure depends on the section of the country where pieris are grown. In the cool Northwest it is possible to plant the southern *P. floribunda* and Japanese pieris (*P. japonica*) in full sun, but they perform better in filtered light. In parts of the U.S. where summer sun is hot and winters are cold and dry, some shade is desirable. However, too dense shade will inhibit flower production. *P. japonica* and the slightly hardier *P. floribunda* survive winters satisfactorily in most parts of the North, but the former will benefit from a protected site in central New England.

In the Northwest, pieris appear to be very pest resistant, although I have occasionally seen plants attacked by a root weevil. Mites and scale have also been reported, as well as a root rot, dieback and leaf spot disease. Lace bugs, which cause the foliage to become yellow or mottled gray, are sometimes troublesome in the northeastern states, especially when the plants receive too much sun. Control by spraying affected plants with Sevin in mid-spring at two-week intervals, making sure that the leaf undersides are treated.

P. japonica is the most widely planted pieris, and seems to be the most dependable for general landscape use in the East. It can ultimately grow to 12 or 15 feet under optimum conditions, but it is most often seen as a considerably smaller, spreading shrub nearly as wide as tall. The new growth in spring is a warm bronze color, providing a fine contrast with the older deep green leaves. Certain plants flower so profusely that the foliage is nearly obscured, sometimes for over a month. The flower clusters are always pendulous. Japanese pieris is variable in flower and leaf, and several highly desirable cultivars have been selected. Among them are:

'Dorothy Wyckoff'—Foliage nearly plum-colored in some winters if grown in full sun. The flower buds are a deep mahogany color in winter. They open to light pink or white bells in early spring. In summer, the leaves are a deeper green than in the typical form, and the petioles are reddish.

'Pygmaea'—Dwarf, seldom to more than 2 feet. The slender inch-long leaves, arranged in irregular whorls on the branches, are so distinct from other pieris that gardeners may mistake the plant for a small conifer—until it flowers. It is really grown for its foliage and diminutive size, since flowers are not commonly borne. When they do occur, they are about as large as in typical *P. japonica*, but are few to the stem and more tender. This cultivar is less hardy than the species, and one grower in the Northeast, Harold Epstein of Larchmont, New York, reports that it is ideally grown as a cold greenhouse plant there, although it will survive winters outdoors, too.

'Variegata.' The leaves have attractive white edges. Similar to, but less vigorous than the type. New growth has a good red color. The light leaf color can brighten a dark corner of the garden. As with many other variegated-leaf shrubs, gardeners

University of Washington Arboretum by E. F. Marten

The Himalayan pieris *(P. formosa)* is a large plant with leaves 5 inches long and long drooping flower panicles. The new leaf color is red.

A single flower spray of the Japanese pieris or andromeda *(P. japonica)* is spectacular. The bloom period is a long one and lasts for many weeks.

Marjorie J. Dietz

Variegated form of Japanese pieris.

must be on the alert to cut out the normal fully green leaves that occasionally appear.

Other selections have been named, some like 'Whitecaps' and 'White Cascade' for reportedly large, long-lasting flowers, and a few have more-or-less pinkish flowers. One cultivar, 'Nana,' is smaller in all its parts, but it is unstable and may sometimes develop foliage and vigor that is typical of the species.

P. floribunda, known variously as fetterbush, mountain pieris and mountain-andromeda, is native to higher elevations of the southeastern United States, and is the easiest pieris to grow in the Northwest. In the Northeast, it is said to be not quite as adaptable as the Japanese species. Fetterbush eventually becomes an erect or rounded shrub about 6 feet tall. It may be distinguished from *P. japonica* by its erect flower clusters that stand out well above the foliage, which is a somewhat lighter green color.

'Forest Flame,' a hybrid between *P. japonica* and Chinese pieris (*P. formosa* var. *forrestii*), was a fortunate mating of a hardy and a tender species that resulted in a more hardy plant with the desirable characters of the tender species. It is an erect shrub with bold green leaves that are an intense flame red when young, a condition that lasts for several weeks in early spring. The new growth has been compared to poinsettia in brilliance of color. I have found the red new leaves fade slowly to nearly white and in this condition they sometimes sunburn on a hot day in April or early May if they are exposed to full sun. This lovely hybrid, which originated in England, has large drooping clusters of the typical white bells of both parents and is their equal in flower. It is not as hardy as *P. japonica.*

These are the most commonly grown pieris, but perhaps a word about some of the less known species would be in order. Most, unfortunately, will not be found in local nurseries or garden centers, but all have been grown in various botanic gardens or arboreta and to some extent are available from specialists.

Himalayan pieris (*P. formosa*) is a tall vigorous plant, with dark green leaves up to 5 inches long, and long drooping panicles of white bells. Its new foliage is bronzy-red. It is somewhat tender and may be damaged by cold winters, and is therefore most useful in the South and West. Even more tender is Chinese pieris (*P. formosa* var. *forrestii*), which has such lovely red young leaves that it is often used (despite its lack of cold resistance) in areas where it may be killed by severe cold.

Taiwan pieris (*P. taiwanensis*) is similar to the above and flowers in very heavy upright panicles when quite young. Its value is that even when damaged by winter weather, it will often recover enough to flower the spring of the following year. Some of the plants under this name appear to be confused in the trade, but a recent re-introduction by the U.S. Department of Agriculture will eventually find its way into gardens. In Taiwan the species grows at different elevations—up to 11,000 feet—and there are likely variations in hardiness. ◆

THE MADRONA—Pride of the Pacific

Joseph A. Witt

VISITORS to the West Coast are often struck by the appearance of a native tree with lustrous evergreen leaves and polished reddish-brown trunk. If they are touring in California, they are told it is madrone or madrono; if in the Northwest, madrona; in British Columbia, arbutus.

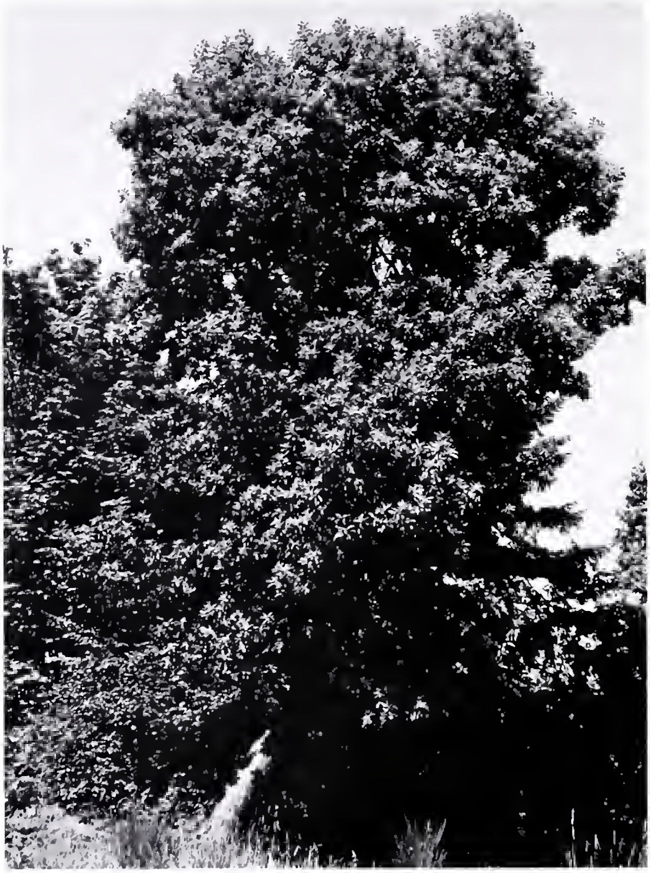
Arbutus menziesii—this tree of many names—grows along the coast from the lower tip of Vancouver Island south to Baja California, usually not far from salt water. It is also sometimes found on the western slopes of the Cascade mountains, in the Sierra Nevada and the California Coast ranges. At maturity, madrona is commonly a round-headed tree, 40 to 60 feet tall (occasionally 100 feet). Clusters of small, pinkish or white waxen bells, resembling blueberry flowers, appear in spring—late April to early May here in Seattle. The attractive bright red fruits that ripen later in the year are eaten by many kinds of birds.

One of the reasons why this striking tree member of the heath family isn't better known is that it does not seem to be a tree for anywhere in the U.S. except its native range, and even there it is hard to transplant. (Plants grow quite successfully in England, though.) Madrona requires sharp drainage, full sun and acid soil. Like many plants native to the Pacific Coast, it is accustomed to a distinct summer drought period, a fact anyone attempting to grow the tree out of its range should consider.

Madrona is beautiful in summer or winter because of its shining foliage and spectacular bark, which is red to terracotta depending on age, but it is probably best grown in an informal or natural part of the garden where its few unpleasant traits won't be too noticeable. Leaves are shed during a two-to-three week period in

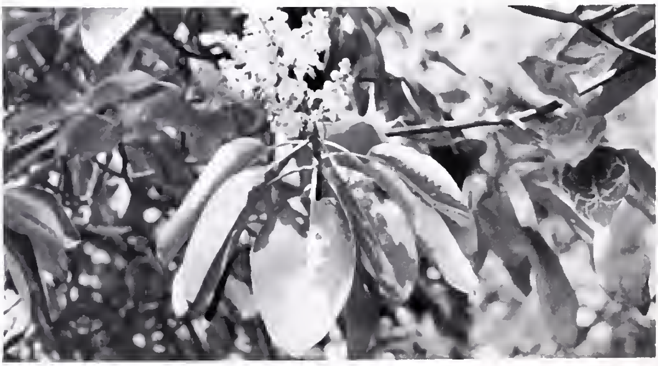
Trunk of the madrona in the Arboretum of University of Washington, Seattle.

midsummer. Large flakes of bark fall soon after, and the ripe fruit can be messy in late autumn (don't plant next to a path). Those of us who are fortunate enough to have a madrona in our garden take great pride in its strength and distinctiveness and freely forgive the tree its sins. ◆



Madrona tree in the Park Department property off Yesler St., Seattle. Its height in 1955 was 40 feet.

University of Washington Arboretum by E. F. Marten



Flowers of the madrona tree (*Arbutus menziesii*).

Native plants to appreciate in the wild,
but a few are adaptable to garden cultivation

THE MANZANITAS OF CALIFORNIA

Lee W. Lenz

THE manzanitas are evergreen shrubs native mostly to western North America, with their range extending south to Guatemala. The genus, *Arctostaphylos*, which may contain 70 species, has one species, *A. uva-ursi*, which is found in both the Old and New Worlds, and is widely distributed from the West Coast to the East Coast.

Many manzanitas are well known natives in California, where the various species form an important component of the chaparral plant community. (Manzanita is a Spanish word, meaning "little apple," an illusion to the often colorful fruits found in many species of *Arctostaphylos.*) Many species are difficult to identify and to compound the problem, there is much hybridization in nature as well as in the garden.

Some species form large burls at or just beneath the soil surface from which new growth quickly sprouts after fires. Nonburl-forming species are killed and replacement is by seeds whose germination may be hastened by heat produced by the fires.

The manzanitas, in some species, produce intricately branched and twisted stems whose shredding outer bark discloses the beautiful smooth red, brown or black inner bark—so admired by flower arrangers that many areas have been stripped of plants to supply commercial needs. In most places the plants are now protected and severe penalties are imposed for gathering manzanita branches.

Various species of *Arctostaphylos* have found some use in gardening in the West, but with the exception of *A. uva-ursi*, have been unsuccessful in other parts of the country. Many of them are specifically adapted to the Mediterranean type of climate where moisture is received during the late fall and winter and growth and flowering take place during winter or early spring. The plant's normal dormant period is during the long hot and dry summer.

One of the species which is grown in California is *A. nummularia*, which forms a low or prostrate shrub with dark, shiny green elliptic or ovate leaves. It hybridizes with *A. uva-ursi* and many of the hybrids make desirable garden subjects. *A. edmundsii* forms a spreading mat up to 2 feet high with red-margined leaves and pale pink flowers. This species, now thought to be of hybrid origin, is one of the most satisfactory for southern California gardens. A. 'Point Reyes' is perhaps the most useful manzanita as a ground cover in southern California where it forms dense mats not more than 14 inches high, the stems densely clothed with rather small, ovate deep green leaves. The original plant was collected at Pt. Reyes, north of San Francisco, where

Arctostaphylos standfordiana

Photographs from Santa Barbara Botanic Garden

Arctostaphylos hookeri **has white or pink-tinged flowers and is often cultivated.**

it grew on a high bluff above the ocean. It is believed to represent a natural hybrid with *A. uva-ursi* as one parent. Other species sometimes encountered in California gardens are: *A. hookeri* and its subspecies *franciscana,* a low growing shrub with small ovate bright green, shining leaves and with white or pinkish flowers. This species occurs on sand dunes and in woods near the coast in Monterey County. The subspecies is found on serpentine outcrops. *A. standfordiana* is taller, up to 6 feet, much branched with rather erect leaves pointed at both ends and pinkish flowers. *A. pringlei* var. *drupacea* is an erect shrub, 12 feet tall, with gray-green leaves and pink to rosy-red flowers. In full bloom it is perhaps the most beautiful of the manzanitas.

The summer-holly (*Comarostaphylis diversifolia*) is closely related to the manzanita clan, and in fact was once included in *Arctostaphylos.* The genus has about 20 species, one native to California, the others extending south through Mexico. *C. diversifolia,* the California native, is an erect or sprawling shrub usually growing about 6 feet tall, but it may become erect and tree-like, reaching from 12-18 feet. It produces white flowers which remind one of lily-of-the-valley flowers.

Summer-holly is grown in a few gardens in California, but is not widely known and probably would not be successful elsewhere. The other species are not known to be in cultivation.

A genus also related to Arctostaphylos but with a single species is *Ornithostaphylos. O. oppositifolia* is endemic to a small area in northern Baja California. The plants, first brought into cultivation by the Rancho Santa Ana Botanic Garden about ten years ago, have done well at Claremont, California, where they have proven to be easy to grow, dependable and insect and disease free. This new introduction should be more widely grown in the Southwest where a slow growing (eventually to 10 feet) evergreen shrub is required for background or screen planting. The leaves are long and narrow, opposite or borne in whorls of three, the flowers small, whitish and inconspicuous, as are the small dry brown fruits. ◆

NURSERY SOURCES FOR RHODODENDRONS AND THEIR KIN

Frederick McGourty, Jr.

EXCEPT where noted, the following nursery sources for ericaceous plants issue catalogs or lists and ship by mail or other carrier. Many of the less common kinds are in short supply and generally of small size.

This list has been compiled for the convenience of readers and does not imply an endorsement of any particular firm. In addition to the sources mentioned, which carry a larger-than-usual variety (sometimes in a general nursery catalog), there are many other nurseries, local and mail order, from which rhododendrons and their relatives may be purchased.

If in doubt on where to obtain particular rare species and cultivars of rhododendrons, local chapters of the American Rhododendron Society may be of special assistance. Nurserymen in search of exclusively wholesale sources will find a number of them listed in the Handbook 1200 TREES AND SHRUBS—WHERE TO BUY THEM, available from the Brooklyn Botanic Garden for $1.50. Home gardeners will also find coded sources for most of the common ericaceous plants in the above-mentioned Handbook.

J. Herbert Alexander, 1224 Wareham St., Middleboro, Massachusetts 02346. Blueberries.

Alpenglow Gardens, 13328 King George Highway, North Surrey, British Columbia, Canada. Dwarf rhododendrons and azaleas; other ericaceous rock garden plants.

Avalon Mountain Gardens, Dana, North Carolina 28724. Azaleas and heathers.

Warren Baldsiefen, Box 88, Bellvale, New York 10912. Rhododendrons and azaleas. Catalog $1.50.

Brimfield Gardens Nursery, 245 Brimfield Rd., Wethersfield, Connecticut 06109. Some ericaceous rock garden plants in a general catalog (25¢).

Cape Cod Nurseries (H. V. Lawrence, Inc.), Falmouth, Massachusetts 02541. Heaths and heathers.

Clarke Nursery, Long Beach, Wash. 98631. Rhododendron species. Send want list.

George W. Clarke, 11740 N. E. Marine Dr., Portland, Oregon 97220. Rhododendron species and hybrids. No shipping.

Comerford's, Box 100, Marion, Oregon 97359. Rhododendrons, Exbury and other azaleas. Hard-to-find cultivars.

Covington Nursery, Rte. 4, Starrsville Rd., Covington, Georgia 30209. Glenn Dale and other azaleas.

Bill Dodd Nurseries, Box 235, Semmes, Alabama 36575. Native southern rhododendrons and azaleas.

Eastover Nursery, 44 Eastover Dr., East Northport, New York 11731. Rhododendrons. No shipping.

Fruit Valley Nursery, 2212 N. W. 69th St., Vancouver, Washington 98665. Rhododendrons. No shipping.

Gable's Nursery, Box 57, Stewartstown, Pennsylvania 17363. Gable hybrid azaleas and rhododendrons. No catalog or shipping. Visits by appointment.

Gardens of the Blue Ridge, Ashford, North Carolina 28603. Native rhododendrons and azaleas.

Girard Nurseries, R. D. #4, North Ridge East, Geneva, Ohio 44041. Azaleas and rhododendrons in small sizes.

Gladsgay Gardens Nursery, 114 N. Mulberry St., Richmond, Virginia 23220. Rhododendrons and azaleas. No shipping.

Gossler Farms Nursery, 1200 Weaver Rd., Springfield, Oregon 97477. Rhododendrons.

Greer Gardens, 1280 Goodpasture Island Rd., Eugene, Oregon 97401. Rhododendrons, especially dwarfs.

H. G. Hastings Co., Box 4088, Atlanta, Georgia 30302. Azaleas.

Thomas Henny Nursery, 7811 Stratford Dr., Brooks, Oregon 97305. Rhododendrons and azaleas.

Holly Heath Nursery, Rte. 25A, Wading River, New York. Heathers, Glenn Dale and other azaleas. No shipping.

Indian Run Nursery, Allentown Rd., Robinsville, New Jersey 08691. Rhododendrons. No shipping.

Island Gardens, 701 Goodpasture Rd., Eugene, Oregon 97401. Rhododendrons, Exbury azaleas.

Kammer's, 403 49th Ave. NE, Puyallup, Washington 98371. Exbury azaleas. Send want list.

Kingsville Nurseries, Kingsville, Maryland 21087. Azaleas. No current list.

LaBars' Rhododendron Nursery, Box 111, Bryant St., Stroudsburg, Pennsylvania 18360. Rhododendrons and other plants.

H. L. Larson, 3656 Bridgeport Way, Tacoma, Washington 98466. Seeds of uncommon rhododendrons.

Mayfair Nurseries, R.D. 2, Nichols, New York 13812. Heaths, heathers, dwarf rhododendrons. Catalog 25¢.

Nuccio's Nurseries, 3555 Chaney Trail, Altadena, California 91001. Azaleas.

Oliver Nurseries, 1159 Bronson Rd., Fairfield, Connecticut 06430. Rhododendrons and azaleas. No shipping.

Panfield Nurseries, 322 Southdown Rd., Huntington, New York 11743. Rhododendrons, azaleas and heathers. No shipping.

Orlando S. Pride, Nurseryman and Plant Breeder, 523 Fifth St., Butler, Pennsylvania 16001. Rhododendrons and azaleas.

Rainier Mt. Alpine Gardens, 2007 S. 126th, Seattle, Washington 98168. Uncommon rhododendrons and rock garden shrubs.

Clyde Robin, Box 2091, Castro Valley, California 94546. Manzanitas. Catalog 50¢.

A. Shammarello & Son Nursery, 4590 Monticello Blvd., South Euclid, Ohio 44143. Rhododendrons and azaleas.

Shop in the Sierras, Box 1, Midpines, California 95345. Manzanitas. Catalog 25¢.

Joel W. Spingarn, 1535 Forest Ave., Baldwin, New York 11510. Rock garden rhododendrons. Catalog 25¢.

Sylvan Nursery, 1028 Horseneck Rd., South Westport, Massachusetts 02790. Heaths and heathers.

Tumblebrook Nursery, 635 Simsbury Rd., Bloomfield, Conn. 06002. Rhododendrons and azaleas.

Martin Viette Nurseries, Rte. 25A, East Norwich, New York 11732. Some rhododendrons, azaleas and other ericaceous plants in a general catalog. No shipping.

Watnong Nursery, Morris Plains, New Jersey 07950. Box huckleberry, sand-myrtle and other ericaceous plants. No shipping.

Weston Nurseries, East Main St., Hopkinton, Massachusetts 01748. Rhododendrons, and azaleas. No shipping.

The Wild Garden, 8243 N. E. 119th, Kirkland, Washington 98033. Ericaceous plants for the rock garden. Catalog $1.00.

Zolling Nursery, 6750 S. W. Oleson, Portland, Oregon 97223. Rhododendrons. ◆

Sometimes a happy ending results when different shrubs outgrow their space and are allowed to intermix. Here at Sandwich, Massachusetts, an evergreen azalea's flowers sparkle in the sunshine against a background of Japanese holly, its companion in willful neglect.

BOOKS FOR FURTHER READING

Gordon E. Jones

Rhododendron Information, published by the American Rhododendron Society, Rt. 1, Box 748, Salem, Oregon, 1967. Helpful information with varietal descriptions including hardiness ratings. $5.

Rhododendrons and Azaleas (second edition), by Clement G. Bowers, published by the Macmillan Co., New York, 1960. The first major book in this country on rhododendrons. Published first in 1936. $12.95.

The Concise Encyclopedia of Favorite Flowering Shrubs by Marjorie J. Dietz, published by Doubleday and Co., Inc., Garden City, New York, 1963. A wealth of information about many of the most desirable ornamental shrubs including many of the rhododendrons and their relatives. $4.95.

Rhododendrons and Azaleas, edited by Philip Edinger for Sunset Books, Lane Magazine and Book Co., Menlo Park, California, 1969. Cultural pointers and background information for gardeners new to these plants. $1.95.

Rhododendrons of the World by David G. Leach, published by Charles Scribner's Sons, New York, 1961. Most comprehensive and authoritative recent book on rhododendrons. $30.

The Azalea Book (second edition) by Frederic P Lee, published by D. Van Nostrand Co., Inc., Princeton, N.J., 1965. The best source book on azaleas published to date. $12.

Rhododendrons in America by Ted Van Veen, published by Sweeney, Krist & Dimm, Inc., Portland, Oregon, 1969. Handsome volume with many excellent color photographs and much practical growing information by one of America's leading rhododendron nurserymen. $20.

Shrubs and Vines for American Garden (revised edition), by Donald Wyman, published by the Macmillan Co., 1969. A comprehensive and most useful reference describing ornamental shrubs that can be grown in the various hardiness zones in the United States and Canada. $14.95.

Trees for American Gardens (revised edition) by Donald Wyman, published by the Macmillan Co., 1969. Like the above book on shrubs, a most useful reference book on ornamental trees. $10.95.

American Rhododendron Society Invites Membership

READERS of this Handbook are invited to join the American Rhododendron Society, a plant society of about 3,200 members in the U.S.A., Canada and other countries of the world. There are thirty-eight chapters of the Society in the United States and Canada, each of which hold regular meetings and annual rhododendron shows. Several of the chapters publish newsletters and sponsor local display gardens featuring rhododendrons. The Society issues a 68-page *Quarterly Bulletin* which contains some photographs in full color. In addition to the *Quarterly Bulletin,* the Society publishes a book at approximately five-year intervals of plant and flower ratings and descriptions of rhododendrons and azaleas. (See above list of recommended books for the latest publication in this series, *Rhododendron Information,* available now for $5 postpaid.) The current dues for membership in the Society are $10 for the year, with $3 of that amount going to support local chapter activities.

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52.	**Handbook on Weed Control** *an end to crabgrass, other lawn pests, weeds in flower beds and in vegetable gardens; herbicides; picture dictionary of weeds*	$1.25
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Paris Trail for N. Y. S. Agric. Exp. Station

Apples are the most adaptable of temperate-zone deciduous fruits. (Left): Apple 'Empire' is a winter variety of the 'McIntosh' type. *Below:* Apple trees in flower are attractive landscape assets.

George Taloumis

LETTER FROM THE BROOKLYN BOTANIC GARDEN

With this special-feature issue of **PLANTS & GARDENS**, Guest Editor George L. Slate brings together for the home gardener the most recent information on fruit-growing, one of the oldest arts known to man. As long ago as ancient Greece, the skill of grafting was commonplace, allowing the perpetuation of superior varieties of fruit trees. In the New World, one of the first reports of fruit-growing came in 1577 when Bartolomé Martinez wrote the King of Spain that he was planting oranges, figs and grapes in Florida. On the local scene, in New York—or New Amsterdam as it was then known—Hendrick Van Dyke had a peach orchard, the bounty of which was as much favored by the Indians as it was by burgher Van Dyke, who drew his musket upon a squaw he caught appropriating the fruit. Result: the Indian massacre of 1655, in which 200 settlers were killed or carried off.

American horticulture, for the better part of its history, has concerned itself with fruit-growing. Only in this century, in fact, have ornamental plants overshadowed fruits in popularity. However, the continued success of numerous mail-order nurseries devoted exclusively to fruit plants shows that the shadow is not a somber one. In all likelihood, the interest of conservation-minded young people in returning to the soil today augurs well for pomology.

As several Contributors to this Handbook point out, some fruit trees and shrubs have unusual ornamental merit. Apart from the striking beauty of Oriental persimmon, Chinese chestnut and highbush blueberry, there are two less common ones grown at the Brooklyn Botanic Garden that are favorites among visitors. For a few days in mid-April, the Japanese apricot *(Prunus mume)*, with its light pink flowers, is one of the most attractive trees in the Garden. A week later, the Japanese plum *(Prunus salicina)* catches the eye because of its numerous small pure-white flowers closely set along horizontal, wand-like branches. 'Burbank' is one of several named varieties available in the trade.

Still, the main point in growing fruit trees is their bounty. As the junkyard nature of our surroundings becomes more conspicuous each day, many people are rediscovering the simple yet exquisite joys of a tangy McIntosh apple, the mild foxiness of a Concord grape, and the sweet crunchiness of a Seckel pear—home-grown, picked at the moment of ripeness, and therefore doubly delicious to the grower. The cultivation of the fruit garden entails work, but the rewards can be substantial. Let us thank Professor Slate and the Contributors to this Handbook for providing the essential information with which to begin.

Editor

Frederick McGourty, Jr.

THE HOME GARDENER AS A FRUIT GROWER

George L. Slate

"'Fine fruit is the flower of commodities.' It is the most perfect union of the useful and the beautiful that the earth knows. Trees full of soft foliage; blossoms fresh with spring beauty; and finally,—fruit, rich, bloom-dusted, melting and luscious —such are the treasures of the orchard and the garden, temptingly offered to every landholder in this bright and sunny, though temperate climate."—A. J. Downing: *The Fruits and Fruit Trees of America* (1845).

GROWING fruit in the garden can be a pleasant, diverting and challenging pastime. The cultivated fruits provide a far greater range of flavors, colors and forms and variations in ripening periods than is often realized. There are also many unforeseen bounties and rewarding experiences to be had from a well planned fruit garden.

The fruit garden should be considered a hobby. It ought to be planned and managed to provide a succession of the best quality fruits from the first strawberry to the last apple. In the care of this garden a multitude of challenging problems will be encountered. In solving them, horticultural skills will be developed that will make the project more engaging as the years go by.

The pleasures of a fruit garden are several and very substantial. The great advantage of growing one's own fruit is to enjoy delicious fruits at their best and to have high quality varieties fully ripe and fresh from the plant. Only those who have eaten fruit like this know how good it is, and just how poor is much of the fruit available on the market. The average person has had no opportunity to develop a discriminating taste and admiration for the flavor, aroma, colors and forms of the best fruits. His standard of excellence is low. The commercial fruit industry requires that a variety be very productive, eye-appealing and as durable as possible. If it has good quality it is rarely allowed to develop, because the fruit must be hurried to market in as durable a condition as possible before someone else gets there with his hastily harvested fruit. With our markets full of this kind of inferior produce, it is little wonder that L. H. Bailey wrote, "Our desire for fruits is mostly uncritical, easily contented, and confined within narrow and uninteresting limits."

Fruit is healthful and there is far too little of it in our diet. It contains vitamins (in a very pleasant form) and minerals. Children should have access to all the fresh fruit that they can eat. Strawberries, peaches, grapes and all the other fruits in season, picked direct from the plant, provide pleasant and never-to-be-forgotten childhood experiences. Good fruits are far more healthful than the trashy candies that are so easy to get.

Fruits are very important in the kitchen. They can be made into a great variety of delicious products, as many of the promotional cookbooks of the fruit industry attest. Frozen or canned, they are available throughout the year. Jellies, jams, preserves, butters and juices in surprising diversity can come from the home fruit garden. Our ancestors dried them and made their own fermented beverages. Even today, some home gardeners pursue the time-honored hobby of winemaking and grow special grape varieties for that purpose. One special point that is sometimes overlooked is that there is much satisfaction in growing fine fruit and offering it to one's guests and friends.

Fruit plants have some landscape value. Many of the tree fruits are handsome in flower. A tree of ripening fruit, a

George Taloumis

An aged apple tree should be cherished—not only for its beauty but its fruits as well.

laden vine, or blueberry bush are all inviting to look at. The neatness of a well laid-out and cared-for planting is pleasing to the eye. Lastly, the surplus of a strawberry bed or of a raspberry patch can provide pin money for children or for retired persons who want to occupy their spare time profitably as well as pleasantly.

Home fruit-growing also has its drawbacks and these must be recognized and circumvented, or the project will fail. The tree fruits are all subject to various insects and diseases. Some of these will destroy or greatly reduce the usefulness of the fruit, and some will weaken or even kill the tree if they are not controlled.

There are weather hazards, especially in areas with climatic extremes. Late spring frosts, early autumn frosts, low winter temperatures and periods of extended droughts provide major risks in fruit-growing. There are, however, some fruits for nearly all agricultural regions. There is no reason why the home gardener cannot do a creditable job of starting a fruit garden where he will soon reap a harvest superior to any offered in the supermarket. ◆

SITE AND SOIL FOR FRUITS

Nelson Shaulis

ONE of the most important factors in the growing of fruits successfully is the site. For the commercial grower, the main question may be which of several locations he should select for a certain crop. For the home gardener with a small yard, the question may be whether or not to plant a particular fruit in the only site available. Whatever the different procedures they may follow in raising plants, both must heed the immediate surroundings, or environment—above and below ground level—where the plants are to be grown.

Temperature

Consider first one of the common causes of failure with fruits in the home garden, especially in the northern United States—low temperatures. Such temperatures of course are most pronounced in winter and can cause serious damage then, particularly to borderline-hardy plants, but they may also injure flowers and new shoots of normally hardy plants in spring during an unseasonable cold spell. In autumn they can, in a sharp change of the weather, freeze the fruit crop or kill growth that has not sufficiently matured. Some kinds of plants are by nature more resistant to winter injury than others, and a gardener can lessen the effects of low temperatures by the proper selection of site, as well as of plants for the site.

Entire books have been written on low temperature injury to fruit plants, but the home gardener need only ask a few essential questions. Is the plant usually reliable in your area? The county agricultural agent can tell you. Does your particular site have characteristics that make it average, or is it superior to the area? If you live neither at the top of a windswept hill nor at the bottom of a slope, where cold air drains from higher elevations, the location is probably satisfactory. How is soil drainage? If it is poor, the chance of low temperature injury will be greater.

Shade as a Problem

Shade from overhanging branches or nearby buildings is another major cause of failure with fruit plants. Professor E. G. Christ stated the case very well in PLANTS & GARDENS some years ago: "The space available in full sunshine determines the size of the fruit planting." At my home, even the supposedly shade-tolerant red currant does not bear well because it is shaded by trees. Grape vines grown in partial shade have fruit that is inferior in quantity and quality to that grown on vines in full sunlight. Compounding the problem, some fruit plants are such dense growers that they need thinning so light will filter to the inner leaves and permit good flower and fruit production. If they are left unattended—and in shade—little or no crop can be expected.

Apart from the shade they cast, large trees pose a problem to the fruit garden by root competition. The only effective solution is to locate the garden a considerable distance away from such trees.

Soil

Turn now to the soil itself. The ideal fruit garden—seldom seen—has well drained, fertile, sandy loam that is at least 4 feet deep. The realities in your lot may include poor drainage, absence of topsoil, and an infertile clay subsoil that is only 2 feet deep before bedrock is encountered. Serious as these obstacles are, they can usually be at least partially overcome.

For fruit plants the most important soil characteristic is good drainage. Drainage can usually be improved by subsurface tiles or by growing plants on raised beds or ridges. Watch out for one inadvertent danger—don't let surface water drain onto a planting from a diversion ditch or furrow. Artificial drainage procedures won't cause the soil to equal a well drained one, but they can make it usable.

Increasing Soil Depth

If the topsoil is shallow try this: grow the plants in elevated rows where topsoil (and, if available, compost) has been added from other parts of the garden, and mulch the rows liberally. This will eventually provide a greater soil depth for the roots. Another approach but much less effective would be to sow a cover crop for a year or two before planting the garden. Irrigation and fertilizing can also help compensate for an inadequate soil depth. Bear in mind, too, that the choice of bush fruits, which are less demanding than tree fruits, will increase your chance of success where the soil is less than ideal.

The purpose of soil management is to make available enough water and nutrients for the satisfactory growth of a plant. In a rainy season when mature plants are grown in deep fertile soil, there is no problem of water and nutrients; you may not have to add any at all. However, when plants are grown on shallow and infertile soil in a season of low rainfall, the need for irrigation and fertilization is certain to be high. Important point: soil management is not a particular practice but it varies according to the needs of the plant, the characteristics of the soil, and the weather.

Value of Mulches

Readers will notice that several other contributors to this Handbook stress the use of mulches. The value of mulches in the fruit garden is great. One-half pound per square foot, or ten tons per acre, of dry waste hay, straw, lawn clippings, leaves or similar material spread over the garden will suppress weeds and last more than a year.

For well drained soils, the major benefit from such organic mulches is a more uniform and high supply of water by the reduction of runoff and evaporation and weed control. In addition, the release of nutrients, such as nitrogen and potassium, reduces the eventual need for fertilization. (Initial use of nitrogen fertilizer will help compensate for the temporary loss of nitrogen as the mulch decomposes.) The rooting of fruit plants in the surface inches of the soil, and even above the soil in the decaying mulch, tends to increase plant growth.

George Taloumis

Mulch around peach tree should be kept a few inches from trunk to foil mice.

Preventing Mice Damage

Mice damage, which occasionally occurs when mulches are used, can be minimized by surrounding the trunks of fruit trees with fine mesh wire guards and keeping the mulch a short distance from the base. Also, eliminate any weeds that may be in this non-mulched circle about the tree trunk.

A word about fruit plantings on lawns (*i.e.*, sod). In general, they are not satisfactory, although on deep fertile soil an established apple or pear tree can grow and produce well if the lawn is given nitrogen. As with mulches, protect tree trunks from mice with wire mesh.

(*Continued*)

Fertilizers

Nitrogen fertilizer is generally the most important nutrient for the home fruit garden. Most common use: in a mixed or so-called "complete" fertilizer containing 10 percent nitrogen such as 10-6-4 or 10-10-10, and broadcast over the entire planting. The amount of actual nitrogen per acre that can be successfully used varies from zero to 80 pounds. None at all might be needed if the soil is fertile and a mulch of strawy manure or legume hay has been used continuously, and if the plants have long shoots with dark green leaves. The maximum amount of nitrogen might be required on sod where the underlying soil is poor. Fruit trees growing in such conditions are apt to have light green foliage on shoots which stop growing early in the season.

For greatest effect, apply nitrogen fertilizer in early spring about the time buds swell and show green. The correct rate can be determined by noting the amount of growth and the color of the foliage, and that depends on the soil, soil management, pruning severity, and level of cropping. Ten pounds of nitrogen per acre is equivalent to 2.3 pounds of a 10 per cent nitrogen fertilizer per 1000 square feet of soil surface. A moderate application of 50 pounds nitrogen per acre would thus be 11.5 pounds of a 10 per cent nitrogen fertilizer per 1000 square feet of soil.

Soil Deficiencies

In a very few instances soil may be deficient in potash, magnesium, manganese or, rarely, iron or boron. If you suspect such deficiencies, a good book to consult is *Hunger Signs in Crops:* a symposium prepared by S. A. Barber, John C. Cain, R. L. Carolus (and others). Howard B. Sprague, editor-in-chief; third edition, 1964; David McKay Co., New York. One other point: in general, the use of lime to decrease the soil acidity in fruit plantings is not beneficial. If the soil is especially acid, concentrate on growing blueberries (see pages 19-21, also New York State Extension Bulletins 900 and 913). ◆

Bud Mutations or Sports

FRUIT varieties occasionally mutate or produce "bud sports"—as they are popularly known. Spontaneous changes occur in a cell in the growing point. The changed cells continue to divide and increase, and eventually can affect enough of the plant to be noticeable to a careful observer.

The commonest mutations of commercial importance are the red or solid color mutants of apples which originally have a striped red color. These solid red apples are considered more attractive than the striped apples; also they color earlier, but do not mature earlier, hence they are sometimes harvested before they are fully ripe. Large numbers of color sports of 'Delicious' have been found, and several are now important varieties. 'McIntosh' and other red apples have produced solid, red bud-mutations which are now being grown in preference to the older striped clones. Giant types, or tetraploids, occur occasionally, and several are being used by apple breeders.

Peaches sometimes produce mutant branches that ripen the fruit several days earlier than the parent variety. Peaches without fuzz—nectarines—are another type of mutant.

Large-berried mutants of several varieties of grapes, among them 'Concord' and 'Fredonia,' are known. The fruits are rather watery and not as tasty as the parent variety. 'Fredonia' has produced an unusually large-clustered mutant that is otherwise like its parent. 'Concord Seedless' has also proposed a mutant with somewhat larger clusters and berries.—*G.L.S.*

DWARF FRUIT TREES FOR THE SMALL GARDEN

Robert F. Carlson

DWARF FRUIT TREES are popular these days in large orchards as well as in modest "pick your own" commercial ventures. They have also met with enthusiasm in small home gardens, whether in rural areas, the suburbs, or even in cities. The generally smaller size of today's backyards has made homeowners conscious of low-growing plants of all kinds, and gardeners everywhere are discovering that, apart from space considerations, some of the dwarfs have special advantages over their large kin.

In the case of dwarf fruit trees, the compact growth habit permits them to be somewhat more easily maintained than full-sized or standard trees. The dwarf trees are easier to prune and spray, the fruit is no chore to pick and, importantly, it is borne earlier in the life of the tree.

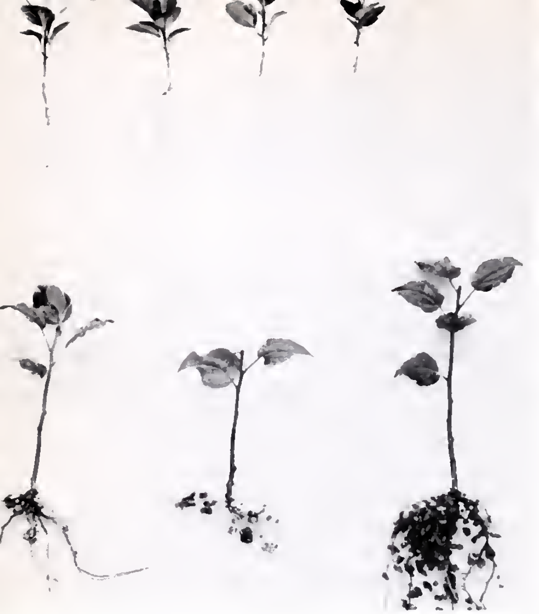
A wide range of dwarf fruit trees is now available from many nurseries. Not all fruit trees can be obtained in dwarf forms, but the growth of every kind may be controlled by pruning, training and branch bending. The growing of dwarf fruit trees is a wonderful hobby, and there is much pleasure in seeing the trees develop and the fruit ripen.

The technique of growing and managing dwarf fruit trees is simple and can be mastered in a short time by the home gardener. Perhaps the greatest consideration in growing fruit trees—dwarf or standard-growing kinds—is that they have to be sprayed periodically for control of various diseases and insects (see p. 60). If the gardener is willing to allow a little extra time for their proper care, especially during the growing season, a good crop of fruit, often more delicious than can be purchased in the market, will usually result.

(*Continued*)

Photographs by Paris Trail for N. Y. S. Agric. Exp. Station

Dwarf fruits, such as this 'Golden Delicious' apple, are suitable for small gardens.



Robert F. Carlson

Top: Apple rootstocks propagated from seed. They are genetically different and are likely to vary in vigor. *Below:* EM VII apple rootstocks of uniform size propagated vegetatively by cuttings.

How Dwarf Trees Are Propagated

Named varieties of fruit trees are propagated vegetatively, because only very rarely do seed-raised offspring inherit the desirable characteristics of the parent. Most fruit trees are budded onto an appropriate rootstock. In the case of dwarf apple trees for the home garden, named varieties should be budded high (14 inches) on a specially chosen dwarfing rootstock. This will enable them to be planted deeper in the soil and to stand firmly against the wind. It will also prevent the vigorous named variety itself from forming roots in the soil and causing the tree to lose its dwarfness. A common lament heard by county extension agents from a home gardener is that one of his dwarf fruit trees has "reverted." In many cases, the scion or top part has formed roots and dominated the growth of the tree.

To be reasonably sure that you are buying a truly dwarf fruit tree, ask the nurseryman the name of the rootstock on which the named variety is budded. One should never purchase a tree that is called just a "dwarf." It may have been propagated on a vigorous seedling or on a vigorous rootstock, and thus be a disappointment in the small garden. One important point to remember is that the special rootstock—*not* the variety—is the part of the tree that does the dwarfing. The fruit of a dwarf 'McIntosh' or 'Red Delicious' is no different from the fruit of a regular-sized tree of these two varieties.

Kinds of Dwarf Fruit Trees

Relatively few home gardeners will want to propagate their own dwarf fruit trees—and there is no need for this, since "ready-made" trees are very dependable. However, growers of dwarf apple trees should know that, in addition to the standard rootstocks that are too vigorous for small gardens, there are three special dwarfing rootstocks in common use. They are, from the smaller to the larger, EM (East Malling) IX, EM 26 and EM VII. These rootstocks will produce trees in size approximately 30 percent, 40 percent and 50 percent of standard trees, respectively. Most apple varieties now in use are compatible with these three rootstocks. However, the size of the trees may vary somewhat according to the variety and the rootstock combination used.

A different method is used to bring about dwarf peach trees. Named varieties are commonly budded on sand cherry (*Prunus besseyi*), on Nanking cherry (*P. tomentosa*), and on 'St. Julien A' plum. Many plum varieties, similarly, can be dwarfed by using these same rootstocks.

The cherries are more difficult to dwarf. However, work now underway may someday produce dwarfing rootstocks for them as well. Pear varieties can be dwarfed by putting them on certain quince rootstocks. But, in the case of 'Bartlett,' and perhaps others, the compatibility is poor and life expectancy short. The varieties 'Old Home' and 'Hardy' are compatible with quince, and are used as intermediate stem sections (interstocks), with 'Bartlett' as the scion.

Selecting a Place

Dwarf fruit trees require sun for at least three quarters of the day to grow well and to fruit satisfactorily. Don't plant them in the shade of the house, or in the shade of large ornamental trees. Providing the location is a sunny one, the dwarf trees can be planted in various ways. They may be as close as 4 by 6 feet or, if space is available, 10 by 20 feet. Since they are small and set fruit early in life, the size of an individual tree can be held to a height and spread of 8 feet or less. To accomplish this, the trees need to be well managed throughout their lifetime.

How to Plant

A large hole should be dug to allow for the spreading of the roots. A good loam soil is excellent to place around the roots, and if the soil is of a poor texture some compost or other well decayed organic matter should be thoroughly mixed in. Best time for planting is from late March to early May in the northern states. A good watering is recommended at planting time and will also be desirable in dry periods through the summer, particularly in the first year, but also in subsequent years to help the tree grow and bear a larger crop of fruit. Mold a depression around the base of the tree to make watering easier and more effective. Proper care of dwarf trees after planting is very important. They need to be fertilized, pruned and trained every spring.

Pruning and Training

In general, fruit trees should have 5 to 8 branches by the fifth year. Bending semi-upright branches into a more horizontal position will help produce a lower, more compact tree. This is especially important with apple varieties such as 'Red Delicious,' 'Winesap' and 'Northern Spy.' A short stick with a nail in each end can be inserted between the trunk and the "scaffold" branch to help keep it horizontal. Make sure that the scaffold branches are well formed. Also, maintain a central leader on the trunk. Remove distinctly acute-angled branches.

A young peach tree properly planted. A saucer-shaped basin has been left at base of tree to hold water. Label has been tied loosely to avoid girdling.

Various ways can be improvised in growing fruit trees to fit them into the landscape scheme as ornamentals. A trellis is attractive if the branches are trained along a wire or a board fence in espalier fashion. The trees also can be shaped into a pyramid or a narrow wall-like structure, or even a hedge, although careful selective pruning will be needed to form much fruit.

Most pruning should be done during February or March. In addition, summer pruning by pinching back some of the succulent growth is helpful in keeping the trees small. The rootstock does most of the dwarfing, but supplementary pruning can be done to train and shape the trees into different forms.

Buying Tips

Select a nursery close to home if possible. Check to see if the nurseryman has the varieties you wish to plant. And most important, find out if they are available on the dwarfing rootstock which will perform best in your backyard. Particularly if it is a nursery specializing in fruit trees, ask for a nursery catalog and study the varieties and their rootstock combinations.

Suggested Varieties

Apples, in order of ripening—from early to late: 'Lodi,' 'Quinte,' 'Beacon,' 'Paulared,' 'McIntosh,' 'Macoun,' 'Spartan,' 'Cortland,' 'Jonathan,' 'Red Delicious,' 'Golden Delicious' and 'Red Rome.' These should be on either EM IX, EM 26 or EM VII rootstocks.

Pears: 'Bartlett' and 'Clapps Favorite' are of good quality and pollinate each other. For best results they should be on 'Bartlett' seedling rootstock. The quince rootstock is not generally dependable. Standard pear trees can be trained into dwarf trees by bending the branches into espalier forms, or by spreading the branches when the trees are young.

Peaches: 'Garnet Beauty,' 'Richhaven,' 'Glohaven' and 'Redhaven.'

Sweet cherries: 'Vista' (black), 'Emperor Francis' (white), 'Schmidt' (black) and 'Hedelfingen' (black). **Tart cherry**: 'Montmorency.'

Plums: 'Santa Rosa,' 'Stanley' and 'President.' ◆

Robert F. Carlson

A four-year-old tree of 'Red Delicious' apple which has been dwarfed by planting on EM 26 rootstock. The result: a good combination for back-yard fruit gardens.

CANE AND BUSH FRUITS

Donald K. Ourecky

CANE and bush fruits—raspberries, blackberries, currants and the like—can be grown successfully in the United States over a broad area from the Pacific Northwest to Maine. They perform most satisfactorily in cooler climates with adequate rainfall. They are not well adapted to the South nor to the Central States where the summers are hot and dry and the winters severe.

Because of the wide range of varieties available, cane fruits can be picked from late June until frost. For the gardener they are an endless delight; for the housewife or retired couples they can even produce a supplemental income, and for the roadside stand or "U-pick" operation, they can provide a good living.

Cane fruits are relatively simple to grow, providing a few principles on soil and site selection, cultural methods, and disease and insect control are followed. Attention should also be given to the selection of varieties (see page 56). One suggestion, which can apply equally to home gardener or commercial grower, is that it is best to start on a small scale and learn by experience. Also, a grower cannot neglect a planting and expect it to return high yields.

Site and Soil

The best possible location should be used for a cane or bush fruiting planting because yield is associated with performance and the longevity of the planting. The life of a planting can be extended indefinitely by maintaining high fertility and controlling insects, diseases and weeds. Low spots which are poorly drained or do not have good air drainage should be avoided. Plants protected from strong winds by woods or windbreaks are less subject to breakage of canes, loss of fruit and severe winter injury. Also, avoid shady locations.

Cane or bush fruits may be grown on a wide range of soils, but a deep rich sandy loam, well drained and with a good organic content and texture is most desirable. Black raspberries perform slightly better on a sandy type of soil. Propagation is also easier because such plants increase by tip-layering. A good moisture supply in the soil during the entire growing season is essential for proper cane growth and fruit production.

Many of the cane fruits are susceptible to root diseases such as crown gall and verticillium wilt. Several years should intervene before raspberries are planted in soils where these organisms are present, or where potatoes, tomatoes and peppers have been grown.

A new raspberry planting should not be made on the site of an old one, or even adjacent to it, because of possible reinfection from virus diseases. Today, virus-free raspberries are available and are particularly recommended, since such a planting may be a long-term investment. No virus-free currants and gooseberries are available. Once a plant has a virus disease, it is impossible to cure it. Remove the plant as soon as the symptoms are noticed. In raspberries, crumbly berries, malformed and mottled leaves are often symptoms of virus infection.

Propagation

Black and purple raspberries are propagated by inserting the tips of the young canes vertically into the soil to a depth of 4 to 6 inches. Unless the actively growing tip is inserted vertically, it may emerge from the soil and continue to elongate, thus producing a poor plant. The tips may be dug in late fall and moved to a new location or dug in the very early spring before growth starts.

Red raspberries are propagated from suckers which emerge from underground roots at various distances from the original plant. The suckers emerge in early spring and mature in late fall. They can be dug and transplanted in the fall, but

'Dundee' Black Raspberry

'Red Lake' Currant

be careful to mulch the newly set plants to prevent frost heaving over winter. Red raspberries may also be transplanted in early spring.

Blackberries are easily propagated as suckers or by 4-inch root cuttings made in autumn and grown in a nursery area for one year. Currants and gooseberries are also readily increased by hardwood cuttings made in autumn after the leaves have dropped. Cuttings may be planted directly into a nursery or bundled and stored in cool moist sand or sawdust until spring. Low branches may be layered by bending them down and covering with soil in the fall.

In home gardens, red raspberries and blackberries are usually set 2 feet apart in rows 8 or 9 feet apart, then allowed to form a hedge about 18 inches wide. Black and purple raspberries do not sucker but form a hill. These hills may be established 2 to 3 feet apart. Currants and gooseberries are often planted 2 feet to as many as 4 feet apart because the bushes eventually become quite large.

Plantings vary greatly in the amount and kind of fertilizer needed to produce good growth. If the organic content of the soil is maintained at a high level, commercial fertilizers other than nitrogen may not be required. Occasional applications of potash may be needed on light sandy soils. Sulfate of potash is preferable to muriate of potash which is toxic to bush fruits. A gardener can, of course, have soil tests made, but the best estimate of fertilizer needs can be made by observing plant growth. It should be noted that a poor plant, however, does not always indicate lack of soil fertility. Disease, poor culture, weeds, inadequate drainage, winter injury and insufficient moisture can also limit cane growth and fruit production. Usually most plantings will benefit from 60-80 pounds of actual nitrogen per acre. This may be applied in an 18-inch band on each side of the plant early in the spring.

Weed control is one of the major expenses in cane or bush fruit culture. Weeds cause low yields and shorten the life of a planting. Perennials such as bindweed, quackgrass and Canada thistle should be eliminated before a planting is made. During the first year, weeds can be easily controlled by frequent light cultivations or hoeing. In some plantings it may be necessary to use a herbicide (see pp. 71-74).

Mulches and Pruning

Mulches serve several purposes and should be considered for use in home garden fruit plantings. They conserve moisture, reduce soil temperature, lessen or eliminate root injury from cultivation, and may prevent erosion. Bear in mind,

'White Imperial' Gooseberry

Phhotographs by Paris Trail

U.S.D.A. 'Thornless' Blackberry

though, that in some cases they may present a fire hazard, serve as a haven for mice during the winter and delay cane ripening in autumn. Straw, old hay, sawdust, wood shavings or similar coarse material, providing it is weed free and economical, are usually very satisfactory. For each ton of mulch about 16 pounds of actual nitrogen may be needed to compensate for that used by organisms in decomposition.

The water requirements of raspberries vary according to soil type, depth of rooting, effectiveness of the mulch and the rainfall of the particular season. However, the soil should not be allowed to become dry at any time in the growing season. Good growth, which is dependent in part upon adequate soil moisture, is essential because the number and size of new raspberry canes produced one year will determine the potential crop the succeeding year.

The fruiting canes of raspberries and blackberries are biennial; that is, they complete their growth in height the first year, bear fruit the second year and die. Currants and gooseberries produce fruit at the base of one-year-old wood, with the greatest production on spurs of 2- and 3-year-old wood. After 3 or 4 years, when the older branches start to bear less fruit, prune them out gradually and let younger shoots develop. For maximum fruiting, raspberries and blackberries grown in a hedgerow system should produce about 10 canes per linear foot of row. If on a hill system, 6-to-10 canes per hill are sufficient. For currants and gooseberries, no specific recommendations on number of canes per hill are made. All vigorous canes are allowed to grow and fruit. Remove only the weak, broken or prostrate canes.

The succulent new first-year canes produced in the spring on black and purple raspberries are generally pruned in mid-June in central New York State, when they are cut back to a height of 18 inches or 2 feet. This type of pruning causes the canes to branch and to make compact self-supporting bushes.

All red raspberries and blackberries are cut back to 5 feet in early spring. If higher, the long lateral shoots, which bear fruit, may be out of reach of the pickers. Laterals of black raspberries are shortened to 6 or 8 inches, and ones of purple raspberries to 8 or 10 inches. Raspberries and blackberries should be picked as soon as ripe and removed to a cool place. The berries deteriorate rapidly in hot sun.

For information on the pests of raspberries, blackberries and currants, see page 66. The occasional insects and diseases that affect such plants should not deter the owner of the small home garden from growing and enjoying them. ◆

GROWING STRAWBERRIES

Roger Lewis

OF ALL the wonderful fruits, the strawberry is the most universally liked and widely enjoyed because of its many attributes. It is probably more easily and quickly grown than any other fruit, readily preserved and frozen and rapidly prepared and served as a fresh fruit delicacy. Its flavor and aroma rival that of almost any other fruit. A crop of standard June varieties can be grown in fourteen months and a smaller crop of everbearing strawberries in six months. With the right conditions and care the strawberry bed can be continued in production for two or three years.

Requirements

Strawberries need full sun all day to bear an abundance of fruit. They can be grown on a wide variety of soils, providing the acidity is satisfactory (pH 5.5 to 6.5 or even slightly higher) and the proper nutrients are supplied. Another requirement is well drained soil. Heavy soils with poor drainage may be used if the plants are set on raised beds or wide ridges, with the alleys between the beds employed for drainage. Sandy soils that have been enriched by the addition of organic matter, and where irrigation is possible, during drought, are often used. Generally, soils that are suitable for vegetables are also suitable for strawberries.

Frost pockets—low spots surrounded by high ground—should be avoided for strawberries, because frequent damage to the flowers by spring frosts will often greatly reduce the crop. If a late frost threatens, however, the flowers may be temporarily protected by hilling up the mulch around them. Also a good point to remember is that the use of a fine mist from a sprinkler—when temperatures fall to 32°F. to 34°F. and kept operating until the danger of frost is well past—has saved many a fine bed of strawberries.

New and desirable varieties are continually being added to the long list of good ones already being grown. Information about old as well as promising new varieties may be had from county agricultural extension services or the state agricultural experiment stations. Different latitudes require different varieties and none is suitable for culture over the whole country.

'Catskill,' introduced more than 35 years ago, is still the standard with which other varieties are compared. It is a reliably heavy yielder, very resistant to verticillium wilt, grows satisfactorily on many types of soil, and is of good quality for eating fresh or for freezing. The finest 'Catskill' berries grow on soils that hold moisture well.

'Raritan,' a new variety from the New Jersey Agricultural Experiment Station, is a mid-season main-crop sort that is finding favor with commercial growers and home gardeners alike. Plants bear many glossy fine-flavored berries. 'Raritan' is not resistant to disease, but it is being grown successfully on soils known to be free from red stele fungus and verticillium wilt, or that have been fumigated.

Other desirable varieties are 'Fletcher' and 'Sparkle,' both ripening in mid-season. Good early-ripening ones are 'Gala,' 'Midland' and 'Sunrise.' Later varieties are 'Vesper' (not disease-resistant) and 'Marlate.' 'Fairfax,' moderately productive, is large, dark red, sweet and of very fine flavor. 'Red Chief' is resistant to red stele, yields well, is fair to good in quality and freezes well. 'Guardian' is similar to 'Red Chief' but lighter red, and the plants are resistant to verticillium wilt. See p. 55 for other good varieties.

Regardless of what strawberry varieties you buy, there is one very important point to remember. Virus-free plants are now generally available from strawberry plant dealers and should always be selected over ones of unknown health, such as gift plants from a neighbor who isn't sure whether they are virus-free.

Photograph by Paris Trail for N. Y. S. Agric. Exp. Station

A straw mulch around strawberry plants keeps the berries clean, aids in conserving moisture and in preventing winter injury and weed growth.

Culture

For a good crop of strawberries, give special attention to the texture and fertility of the soil. Organic matter may be supplied or maintained by turning under a green manure crop the previous year or by applying dried or well-rotted manure or compost. A complete fertilizer of a 5-8-7 or 5-10-5 formula at the rate of 4 pounds to 100 square feet should provide sufficient fertility until the strawberries bear fruit. It should be worked into the soil when the plot is prepared for planting. On light soils repeat the application in mid-August. Fertilizer should be brushed off the leaves, and the bed should be watered if a heavy rain does not come soon. No fertilizer should be applied in the spring of the fruiting year.

Early spring, as soon as the soil can be worked, is the best time for planting. The soil should be as carefully prepared as for vegetables. The year before planting, eliminate perennial weeds, especially witch (quack) grass and bindweed, with herbicides or by thorough cultivation. If the soil contains grass sod which may be infested with white grubs, it is best to grow another crop of plants for a year before planting strawberries; or use an insecticide as described in the chapter on small fruit insects and diseases.

Soil fumigation is practiced by some commercial growers to eliminate nematodes, weed seeds and verticillium wilt. If there are growing problems in your garden due to nematodes, consult your experiment station or extension service for advice on the use of granular or liquid fumigation. To be effective, fumigation must be done the September before planting, and only on well prepared soil.

A new strawberry planting should not be situated where another crop of strawberries has just been grown, or where tomatoes, peppers, eggplant, potatoes or black raspberries have recently been cultivated. Reason: all are susceptible to verticillium wilt, a soil fungus that will seriously injure or kill strawberries.

Strawberry plants should be set in a

slit in the soil made by a spade so that the roots extend straight down (but not crowded). When the roots extend straight down, they are apt to receive more moisture than if near the surface. Press the soil firmly against the roots by stepping on it close to the plant after the spade is withdrawn. The crown should be even with the surface of the ground and the plant held firmly enough to resist a tug. On very loose or roto-tilled soil, the crown should be slightly lower to allow for soil settling which will take place after a heavy rain.

Spacing of Plants

Plants may be spaced 15 to 18 inches apart, in rows 3½ to 5 feet apart. Runner plants, which grow from the original plants, should be set about 6 inches apart to make a row about 20 inches wide (not over 30). Runners formed early in the season ultimately bear much more fruit than do the very numerous runners that are formed later in the year, particularly in autumn. It is a good practice to consider runners produced after early September as weeds and remove them before they are well rooted. Another point: don't set strawberry plants too close together. In very dense rows, fruit rot is more severe when wet weather occurs, and the berries are smaller. Also, picking and spraying are easier if the plants are well spaced.

Another way to grow strawberries is by the hill system. Plants are set 15 to 18 inches apart in the row, in beds of two or three rows, and all runner plants are removed as they appear. This system requires more plants and more labor, but heavy crops of large berries are produced. Also, picking is easier.

In the year when a new strawberry planting is made, it is wise to remove flowers as they appear. This means, of course, that there will be no fruit the first season, but the next year's crop will be abundant. Plants which fruit are slow to produce runners. The flowers should be cut off, not pulled, as pulling may dislodge the plant.

Watering is very important for strawberries, which are shallow-rooted plants that tend to dry out in summer heat more quickly than other fruits. Particular attention should be given to provide adequate moisture at the time of flower (hence fruit) bud formation, which is roughly August 15 through September; and again just prior to and during the fruiting season in spring and summer.

Everbearing Strawberries

Everbearing strawberries are most satisfactory when grown by the hill system, or a modified hill system in which the plants are set 18 inches apart in a single row. Four runner plants from each original plant are set, two on each side of the original plant, so that three rows are formed. To insure a good crop in the autumn of the second year as well as an earlier crop, be careful not to cut off the flowers in the spring of that year. Everbearers require high fertility and an ample supply of water to produce good crops. Also, mulch the plants. 'Geneva,' 'Ozark Beauty' and 'Ogallala' are good everbearing varieties.

Mulching

Mulching is not absolutely necessary but is recommended in the northern United States to guard against winter injury. A mulch also helps conserve moisture, keep weeds down and berries clean. Salt marsh hay, clean straw, pine needles, wood shavings, peanut shells and sawdust are, in that order, desirable mulches. If shavings or sawdust are used, some nitrogen fertilizer should be applied at the same time. Spread the mulch in late autumn before temperatures drop below 20°F. It should cover the plants by at least 2 inches. Don't remove coarse mulches in spring until a slight yellowing of the leaves appears under the mulch, and then remove only enough mulch to allow plants to grow up through. A year-round mulch will add to your success in raising strawberries, one of the most satisfactory and rewarding crops in the home garden. ◆

BLUEBERRIES AT HOME

George M. Darrow

FOR longevity alone, blueberry plantings deserve a high rating. One planting in western Massachusetts—which belonged to a Mr. and Mrs. Dirks—I was able to observe over a eleven-year period. The garden, larger than most blueberry plantings, was already fourteen years old when I visited it the first time; eleven years later it was as fine as ever. The planting, on sloping upland near the Dirks' home, for 25 years had been mulched with sawdust. Additional sawdust was applied every few years to keep down grass and weeds. A frame had been built, which was covered with tobacco cloth during the ripening season to keep out birds.

Mulching

In general in the eastern United States the two practices most necessary for the success of home blueberry gardens are just the two used by the Dirks—mulching with sawdust (or leaves) and covering to keep out birds. In my own garden in Maryland I use leaves, wood chips and sawdust for mulch—leaves as far as they go, and wood chips and sawdust for the remaining bushes. Where quackgrass or strong perennial weeds might come through the mulch, I first put down heavy wrapping paper or cardboard and then use the leaves and sawdust on top of it. I have used any kind of leaves available—bamboo, black walnut, apple, mulberry, and others. The wood chips are from the telephone company pruners; and sawdust I get from a nearby sawmill. The leaves are piled deeply enough to smother grass, and the wood chips and sawdust about 6 inches deep over the whole surface.

Soil

Though the ideal soil for blueberries is a loose sand-peat with some field soil mixed in, most soils of the states along the Atlantic Coast can be made satisfactory. A possible exception is a soil mixed with plaster and lime near a building. In that case a hole at least 2½ feet square and 1½ feet deep should be dug and filled with acid woods-soil or with baled peat moss or sawdust mixed about half-and-half with good soil.

A good blueberry soil should be quite acid (pH 4.0 to 4.8) and contain at least a fair amount of organic matter. If it tests less acid (pH 5.0 to 5.5), regular applications of sulfate of ammonia usually will result in healthy growth. If the soil is only slightly acid (pH 5.5 to 6.5), powdered sulfur should be spread over a 3-foot circle where each bush is to be planted and mixed well in the upper 10 inches of soil. On light soils about 2 pounds of sulfur, and on medium loams 4 pounds, will be needed for ten plants. For good yields, blueberries should not be in the shade.

Planting and Fertilizing

Two-year-old plants are usually best for planting; strong 2-year plants should be about 15 inches high. They are usually

Roche

The urn-shaped pink-white flowers of the blueberry appear in May.

set in early spring, as soon as the soil can be prepared; but from southern Connecticut southward it is usually better to plant in October or November. The bushes should be planted about 6 to 8 feet apart. After the bushes have started growth, a mixed garden fertilizer can be spread in a band 6 to 12 inches from the plant the first year, and in a wider band as the bushes grow older. About one ounce of fertilizer per plant is used for each year of age up to 8 years. After the first year fertilizer is applied twice; the mixed garden fertilizer in April as the buds start, and ⅓ pound of ammonium sulfate for a bush 3 or more years old about June 15. If a 6-inch-deep mulch of sawdust is used, twice as much fertilizer should be used as on unmulched beds. If leaves are used as mulch, one and one-half times as much fertilizer for a 3-inch layer of leaves (after they have packed down) should be enough.

The plants should make a good growth the first year, often 6 to 12 inches. They should bear a small crop the third year and a larger crop each year thereafter. When full-grown they are usually 6 to 8 feet high and about 6 feet wide.

Varieties

It is a little over forty years since blueberry culture first became successful. About 1909 the late F. V. Coville and Miss Elizabeth White began searching the wild for the best native bushes. The selected bushes were propagated and about 1918 the first shipments were made from a cultivated field at Whitesbog, New Jersey. Breeding work was started in 1909 and in 1920 three varieties resulting from this work were named and introduced. Over thirty highbush varieties from Coville's and the author's breeding work and nine rabbiteye varieties from the writer's and cooperators' work have now been named, the later named varieties replacing the earlier ones. Extensive breeding is still being carried on and new varieties can be expected—better in flavor, size, color, productiveness, hardiness, or in season of maturing.

The home gardener has a substantial number of varieties from which to choose. For two persons, two plants each of three varieties may be enough, or for four persons two each of five kinds. At least two varieties should be in every planting to provide for cross-pollination.

From near New York City south to Virginia, varieties to be considered, listed in order of their ripening are: 'Bluetta,' 'Collins,' 'Blueray,' 'Berkeley,' 'Herbert,' and 'Coville.' Fruit of 'Berkeley' is the lightest in color and mildest in taste. 'Coville' is the most tart and the latest to ripen. 'Herbert' has the highest aroma and is the largest. 'Blueray,' 'Herbert,' and 'Coville' are especially fine for freezing, but the others are very good also. All six of these varieties make vigorous bushes. In the vicinity of Brooklyn 'Bluetta' begins to ripen about July 1, and 'Coville' about August 1, producing through August. In North Carolina, 'Wolcott' and 'Croatan' are good home garden varieties.

From eastern North Carolina south to northern Florida and west to Louisiana, the rabbiteye, a southern blueberry species (*Vaccinium ashei*), is especially adapted to home gardens, for it is much more drought-, heat-, and disease-resistant, and more vigorous than the northern highbush species (*V. corymbosum* and *V. australe*). 'Woodard' and 'Tifblue' are the best-flavored of the rabbiteye varieties, but 'Homebell,' 'Garden Blue' and 'Mendito' are also good. At least two varieties must be planted for cross-pollination. Three promising new rabbiteye varieties, larger and with very good flavor, have just been introduced from the Tifton, Georgia experiment station.

Pruning

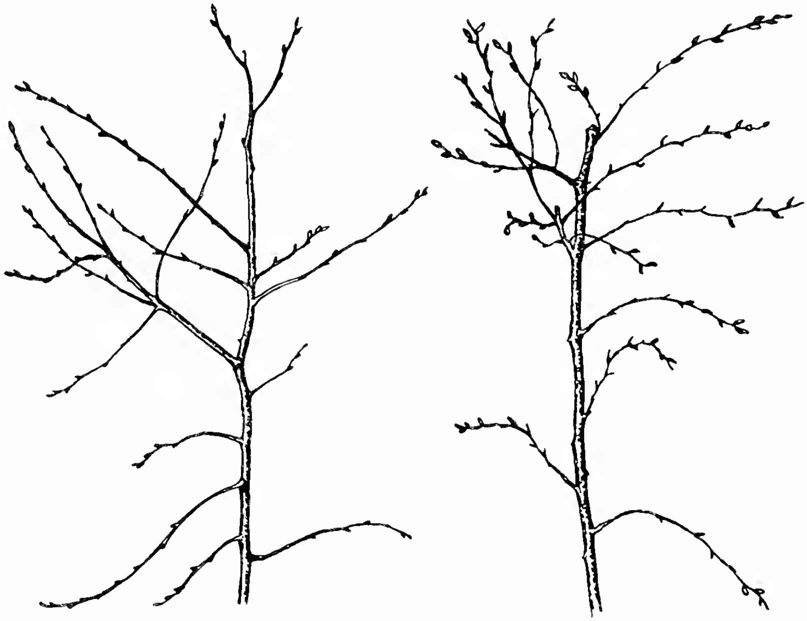
Full-grown bushes, eight or more years old, may bear eight to ten quarts of berries each. Even higher yields can be obtained. In the North, unpruned bushes may bear more than pruned ones. However, the berries on unpruned bushes are relatively small. Light pruning, taking out the small slender branches and leaving the strong vigorous shoots which always produce the largest berries, is recommended. Such pruning should be done in early spring. Farther south, pruning of the highbush varieties is essential, for unpruned bushes may set so heavily that a great many of the berries do not ripen normally and large parts of the bushes die.

Bird Protection

For bird control, covering the bushes with tobacco cloth or plastic-coated paper netting is generally most satisfactory. However, many homeowners may discover that once their bushes become established, there will be sufficient fruits for both birds and humans. Some growers have built permanent wire net (1-inch mesh) cages to enclose their blueberries. (For other methods to keep birds away, see article by R. D. Way and J. A. Sherburne on page 79.)

Landscape Value

The blueberry lends itself well to plantings near the home for it is attractive the year through. In May the bloom is pinkish-white, in the autumn the leaves turn red, and in winter the red and green twigs and red buds are attractive. ◆



Eva Melady from Cornell Extension Bulletin No. 900

PRUNING BLUEBERRIES—The vigorous cane (*left*) has numerous branches which are well spaced and needs no pruning. A sucker (*right*) has been headed back (that is, had its top growth removed) which resulted in the growth of many strong side branches that will bear large berries.

THE ORIENTAL PERSIMMON COMES NORTH

Eugene Griffith and W. H. Preston, Jr.

THE Oriental persimmon (*Diospyros kaki*) is usually thought to be adapted to only the southern part of the United States, but actually it has been grown successfully as far north as Michigan, Indiana, Illinois, New York, Pennsylvania, Maryland and Virginia. Some trees, known to be at least 40 years old, have withstood winter temperatures as low as —20°F. These trees bear fruits annually and are in excellent condition.

The Oriental persimmon typically develops into a small, round-topped, deciduous tree 15 to 25 feet high. The lustrous dark-green leaves are slightly larger (3 to 10 inches long) than are those of the American persimmon (*D. virginiana*), but they are of the same general shape. In late fall the leaves of many varieties of the Oriental persimmon turn a rich yellow, orange or crimson. The fruits also turn yellow, orange or red, adding beauty to the trees with or without foliage. The size and shape of the trees and the beauty of the foliage and fruits make the Oriental persimmon an outstanding ornamental for landscaping, street plantings and the home garden.

A great many varieties exist, mainly in China, Japan and Korea. These countries are densely populated, and the fruit is used extensively. It may well be that the Oriental persimmon is the most consumed fruit in the world—and probably has been for centuries. Marco Polo wrote about persimmons in commerce in China in the early 14th century. Most of the varieties now growing elsewhere in the world have, or had, Oriental names.

Hardy Varieties

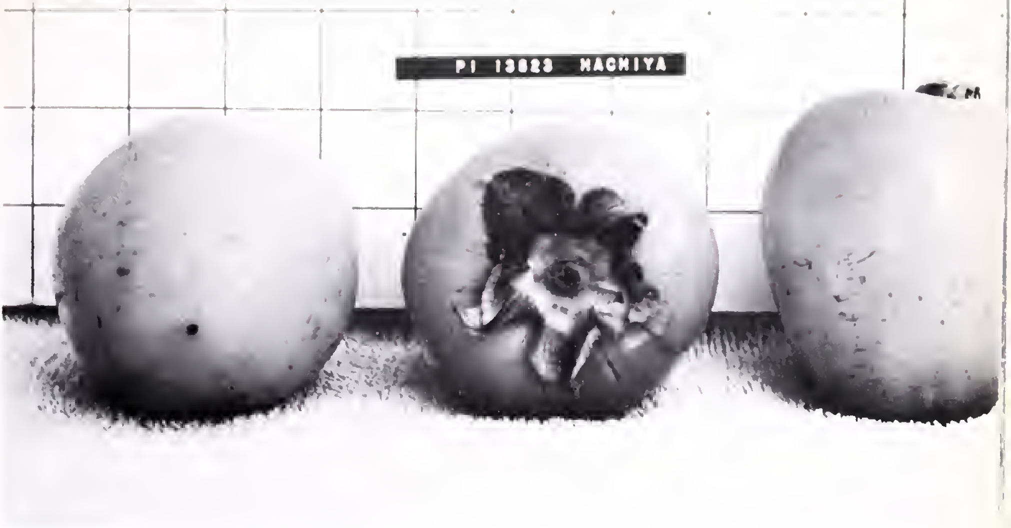
Varieties known to have survived 30 to 40 or more winters in the Maryland, Pennsylvania, Virginia areas include 'Great Wall,' 'Peiping,' 'Pen,' 'Sheng,' 'Shaumopan,' 'Benigaki,' 'Okame,' 'Tsurushigaki,' 'Yokono,' 'Delicious' and 'Manerh'; perhaps many other varieties are as hardy or hardier. The late J. Russell Smith, eminent geographer, in 1925, collected several varieties of very hardy persimmons in North China, near the Great Wall, and introduced them into the United States. Two of these varieties, officially labeled 'No. 1' and 'No. 4,' exist as tall (40 feet) trees in Smith's (now overgrown) original orchard in the Blue Ridge Mountains of northern Virginia. Other varieties known to have survived several to many winters in Maryland include 'Fuyu,' 'Tamopan,' 'Hachiya,' 'Jiro,' 'Suruga,' 'Kochong Si,' 'Saijo,' 'Hyakume,' 'Aizu Michirazu,' 'Kubo,' 'Akadango,' 'Tanenashi,' 'O'Gosho,' 'Giboshi,' 'Square,' 'Twentieth Century,' 'Matsumoto Wasefuyu,' 'Sacock,' 'Kyungsun Ban' and 'Hagakushi.' Several other varieties exist as mature, bearing trees but the varietal names have been lost.

The Fruits

Fruit shapes vary from extremely elongate to tomato- and heart-shaped and may be lobed, square, capped, or constricted, with many gradations and combinations. Size varies from small 1-ounce fruits less than 3 inches in circumference to the relatively rare enormous fruits weighing over 1 pound and measuring 15 inches in circumference.

The flesh of ripe fruits may be yellow, orange, red or brown, and may have a few to many dark brown flecks throughout. Fruits of some varieties are free from astringency and edible while still firm and crisp, whereas others must be soft before they are edible. Some varieties can be slightly stringy. Flavor and sweetness vary considerably with variety.

The eating of persimmons cannot be



Eugene Griffith and W. H. Preston, Jr.

Fruit of 'Hachiya' persimmon, the main commercial variety grown in the United States. The grid pattern is composed of 1-inch squares to indicate fruit size.

easily discussed without mentioning astringency. The reaction to astringency varies with the individual, some being exceptionally sensitive to it while others are unable to detect it. Trees of certain varieties produce fruits of excellent flavor when fully ripe, but are considered less desirable because of their astringency. Astringency, however, is easily removed from Oriental persimmons merely by storing them, when well colored and firm, with ripe apples in a closed container, such as a plastic bag, for 2 to 4 days at room temperature. This short period of storage is sufficient to remove the astringency from the stored fruits.

Persimmon trees are considered dioecious; that is, male and female blossoms generally are borne on separate trees, but sometimes a male tree may have several female flowers, which develop into fruit, and a female tree may have several male flowers. Many varieties show a tendency towards seedlessness in the absence of a pollinator.

Ripening dates of the Oriental persimmon fruits depends largely on variety and location. Ripening can begin as early as September or as late as November. The season for fresh fruits, however, can be extended for several months by refrigeration or storage in a cool (33 to 40°F.) place.

The fruits, while delicious for eating out-of-hand, may also be used for appetizers, soups, fruit salads, ice cream, sherbet, custard, cake, pudding, pie, jam, bread, gravies, yogurt, cookies, dressings, gingerbread, griddlecakes, marmalade, molasses, beer and wine. The fruits can be frozen whole, or pulped and then frozen, for later use. Tannins present in the pulp cause discoloration when iron utensils are used, but plastic, glass, aluminum and stainless steel ware are satisfactory.

A Carefree Fruit

No important disease or insect pest has been noted on the Oriental persimmon in the eastern United States except mealy bugs. These insect pests deform young leaves of vigorous growing shoots, sometimes killing all new growth if left unchecked. They usually are not serious pests of mature trees.

In full sun or light shade, the trees are well shaped and ordinarily require no pruning. The many trees observed have grown for years without the application of fertilizers, and the foliage has remained dark green and healthy. Young trees grown in containers may be injured or killed by small applications of some common kinds of fertilizers. Thus the need for spraying, pruning or fertilizing is at a minimum; nevertheless, mature trees probably would respond to good cultural practices.

Oriental persimmons usually develop new leaves in late April or early May, and produce their small cream-colored flowers in May and June, usually 2 to 3 weeks earlier than do American persimmons. Late-flowering varieties may be best for the northern range of this tree to escape late frosts, but, while early ripening varieties are considered most desirable for many reasons, late-ripening varieties may be picked after hard frosts or light snow.

The Oriental persimmon trees observed rarely grew over 20 feet in full sun, but under tall trees they may grow to 40 feet. Many Oriental varieties have been grafted on American persimmon understock. Union of scions to stock is usually good. Oriental persimmon seedlings, however, may also be used as understock, making satisfactory trees. ◆

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Why Some Grape Vines are Grafted

GRAPE vines are subject to attack by a root-infesting aphid known as phylloxera which is native in the eastern United States. The phylloxera became established in French vineyards about 100 years ago where it did tremendous damage to the industry. About the same time it reached California and became a serious pest of grape vines there. Its destructiveness in these regions is due to the fact that the Old World or European grape, *Vitis vinifera*, which is grown in these regions, is very susceptible to this insect. The vines are weakened and may succumb from its attack.

The grape varieties grown in eastern America vary in susceptibility to the phylloxera. They have been derived in part from the native wild grapes, which through long association with this insect have developed considerable resistance to it. 'Concord' on its own roots in a deep fertile soil, which has not had a vineyard on it previously, performs well. On a site from which a 'Concord' vineyard has been recently removed, control measures, such as use of a phylloxera-resistant rootstock or an interval of 3 or more years between grape plantings, are essential for good growth. 'Delaware' is even more severely reduced in vigor by soil pests such as phylloxera, and control measures are essential in an old vineyard site and desirable on a new site.

The only satisfactory defense against this root insect is to graft susceptible varieties on phylloxera-resistant roots, which have been derived from the native wild grapes by selection and hybridization. Several rootstocks are in use in various grape-growing regions of the world, but in New York 'Couderc 3309' has established its place as one of the best in vineyard trials, and is currently recommended. In California where the *V. vinifera* varieties are grown, 'Rupestris St. George' and 'Aramon x Rupestris Ganzin No. 1' are considered to be the best available phylloxera-resistant rootstocks. More detailed information about rootstocks for grapes in California may be had from the California Agricultural Experiment Station, Davis, California 95616. —*G.L.S.*

NUT TREES FOR THE HOME GARDEN

L. H. MacDaniels

PRACTICALLY everyone who has enough land to develop a fruit garden has an interest in planting trees for their shade and landscape value. For these purposes nut trees deserve special attention, for not only do most of them give satisfactory shade and provide attractive landscape features but they have the additional advantage of furnishing palatable nuts. Nut trees are of many sizes with different forms and foliage textures that will fit almost every situation. Many are interesting because they are unusual and because they bear edible nuts that furnish interest and activity for the children of the family in gathering, curing and cracking them. Certainly greater use of nut trees around the home is to be encouraged. All through the Northeast and Middle West the American elm is being destroyed by Dutch elm disease. This gives opportunity for replacement with nut trees of suitable size and shape.

Climatic Considerations

Nut trees differ greatly in their suitability for different climatic conditions. Some, like the butternut, are very hardy and will grow almost anywhere in the northeastern United States. Some of the hickories share this hardiness. For many nut trees, however, the range over which they will succeed may be limited by low winter temperatures, late spring frosts, short growing seasons, or insufficient summer heat. Areas with less than 150 days between late spring and early autumn frosts are likely to be unsuitable for all but the hardier sorts. Temperatures below −20F. become critical for some Chinese chestnuts, some Persian walnuts, filberts and heartnuts. However, these adverse conditions seldom kill the trees, and the fact that an occasional crop is lost is not a serious matter when commercial production is not the purpose of the planting.

To obtain satisfaction from the nuts harvested, only grafted or budded trees should be planted. There is as much difference between a good grafted variety of black walnut, like the 'Thomas,' and the common walnut seedling as there is between a good apple variety, like 'McIntosh,' and an astringent wild seedling. 'Thomas' is a large nut that cracks easily, giving large kernels of good flavor that are easily picked out by hand. By comparison, the nuts of the average seedling are so difficult to crack and extract the kernels that it is not worth the trouble to gather them. Under such circumstances the nuts merely become a nuisance that adds to the work of maintenance. Grafted trees are available from nurserymen or, if one is sufficiently interested and skillful, seedlings may be planted in place and grafted to the desired variety after they become established. A possible exception to the superiority of grafted trees for the home planting is the Chinese chestnut which often shows graft failure due to stock-scion incompatibility, particularly in the North.

With most species of nut trees under cultivation, many varieties or clones have been selected for their superior qualities of nuts or foliage and given variety names. It is beyond the scope of this Handbook to describe these in any detail. Many have not been propagated commercially or widely grown. The varieties listed here are those considered to be most generally useful and likely to be available from nurserymen specializing in nut trees.

Pollination

Some kinds of nut trees require cross-pollination so this must be given consideration in deciding what to plant, particularly if space is limited. To provide for cross-pollination there must be two different varieties or seedlings planted close enough together that pollen from one will be carried to the other, either by wind or

Photograph by Paris Trail for N. Y. S. Agric. Exp. Station

The nuts of the American hazelnut (*Corylus americana*) are covered by leafy husks.

insects. Often a tree of the same species—but a different variety, in a neighbor's garden—will furnish the needed pollen. Otherwise, provision for cross-pollination must be made when the trees are planted. With filberts, two plants of different varieties should preferably be only a few yards apart. Chestnut also will do best if the trees are separated by only about 100 feet. Hickories and Persian walnuts may bear poor crops unless there are other varieties growing nearby. Butternuts and black walnuts apparently have no pollination problem.

The black walnut (*Juglans nigra*) is an outstanding American tree that grows rapidly to a large size and needs plenty of room. As a lawn tree it has the advantage of giving high shade that is not too dense to allow a good lawn to grow under it. A large tree will furnish all the nuts that a family can use. It should not be planted where the roots will compete with the plants in the flower or vegetable garden because of the apparent toxicity of its roots to tomatoes and some other plants. Among the hardier varieties for northern planting are 'Thomas,' 'Snyder,' 'Sparrow,' 'Patterson' and 'Michigan.' Good nuts, but requiring a longer season (180 days or more) are 'Stambaugh,' 'Elmer Myers,' 'Stabler' and 'Ohio.'

Walnuts

The Persian walnut (*Juglans regia*), or English walnut as it is sometimes erroneously called, made little progress in the northeastern states until hardy forms were brought in from the Carpathian Mountains of Poland. Selections from these original introductions bear nuts of good size and quality and are hardy throughout much of the Northeast. Their chief drawback is that the trees start growth early in the spring with the result that new shoots are killed by late frosts. This does not occur every year, however, and the trees are sufficiently attractive and the nuts valuable enough to make them well worth growing. The trees are self fruitful, but growing more than one tree is advisable because the pistillate flowers of a given variety may not be receptive while the catkins of that tree are shedding pollen. With a second tree there is a better chance of securing pollination. Among the better selections are

'Hansen,' 'Colby,' 'Metcalfe,' 'Jacobs,' 'Schafer,' 'McKinster,' 'Lake' and 'Broadview.'

The butternut (*J. cinerea*) is the hardiest of the nut trees, its range extending into Maine and New Brunswick. The nuts have an excellent flavor that is highly prized locally. Grafted varieties are much superior to the ordinary run of seedlings in that usually whole halves of the kernel can be recovered from nuts correctly cracked from the ends. The trees may be short lived under some conditions due to fungus infection. Some of the better varieties are 'Craxeasy,' 'Thill,' 'Johnson,' 'Van Syckle' and 'Ayers.'

Closely related to the butternut is the Japanese walnut (*J. sieboldiana*). This is a large, rapidly growing tree with a spreading crown and very large compound leaves that give it a somewhat tropical appearance. The nuts are variable, some of them resembling the butternut rather closely and others somewhat smoother. One selection, 'Mitchell,' has good cracking quality but for the most part they are very hard to crack and lacking in flavor. The heartnut is a botanical variety (*J. sieboldiana* var. *cordiformis*) bearing smooth, easily cracked nuts in clusters. The varieties differ somewhat in hardiness. Among the selections are 'Faust,' 'Stranger,' 'Walters,' 'Wright' and 'Fodermaier.'

The Hickories

The hickories (*Carya* spp.) include the pecan and a number of species native to the northeastern states. The pecan, native to the South and Middle West, fails to mature nuts in the North because of the lack of sufficient summer heat. The pecan is, however, hardy in the North and makes a good shade tree. Of the other native hickories, the shagbark (*Carya ovata*) is the most valuable for its nuts. The shellbark (*C. laciniosa*), native mostly to the Middle West, is a vigorous handsome tree, but for the most part the nuts have thick shells and poor cracking quality. The mockernut (*C. tomentosa*), native to the Northeast, is even less valuable for its nuts. Hickory trees are difficult to transplant and slow in coming into bearing. However, a good grafted hickory tree in a dooryard is a valuable asset for its shade and fine flavored nuts. Superior varieties are 'Wilcox,' 'Nielsen,' 'Fox,' 'Glover,' 'Mann,' 'Porter,' 'Wilson' and 'Weschcke.' One narrowly pyramidal clone, 'Holden,' has recently been selected for its ornamental qualities.

Roche

Green husks protect black walnuts.

Hybrids of the shagbark hickory and the pecan make excellent, thrifty shade trees but are usually shy bearers. Varieties available are 'Burton,' 'Pixley' and 'Gerardi.'

The native American chestnut has practically disappeared from the United States where it once made up large forests of trees valuable for timber and nuts. The trees were killed or reduced to shrubs by the chestnut blight and much effort has been spent to find another chestnut species, or to make hybrids that would have resistance to this disease. (For a progress report on the American chestnut, see PLANTS & GARDENS Vol. 26, No. 4 (Winter 1970-71), (pp. 7-11.) The most promising of these is the Chinese chestnut (*Castanea mollissima*). It is a medium-sized, round-headed tree bearing large nuts that closely resemble the American chestnut in flavor. The trees, though not immune to blight, are sufficiently resistant to it to be grown successfully in the blight area. Chinese chestnuts thrive best in light, friable soils that are well drained and somewhat acid. Planting two or more trees, either seedlings or different varieties together to provide cross-pollination, is essential. The varieties 'Nanking,' 'Meiling' and 'Kuling' have been named and propagated and are being grown in orchards in the South. 'Abundance,' 'Crane' and 'Orrin' are other good varieties. Experience in the North, however, has been that grafted trees often fail at the graft union. For home planting selected seedlings are recommended.

Hazelnuts

Filberts or hazelnuts are grown commercially in Oregon. The varieties used there, however, have not been satisfactory in the East. More promising are the hybrids between the European and the American hazel (*Corylus americana*). Selections from this group that are worthy of trial are 'Bixby,' 'Buchanan,' 'Potomac' and 'Reed.' At least two varieties should be planted together for cross-pollination. The plants make a tree or a bush about 15 feet high. If trained as a tree, keeping the suckers pruned away from the base of the trunk is necessary. The Turkish hazel (*C. colurna*) is a clean, shadegiving tree of some ornamental merit that is gradually becoming better known. (A sixty-year-old specimen at the Brooklyn Botanic Garden is 55 feet tall, 35 feet across.)

Culture

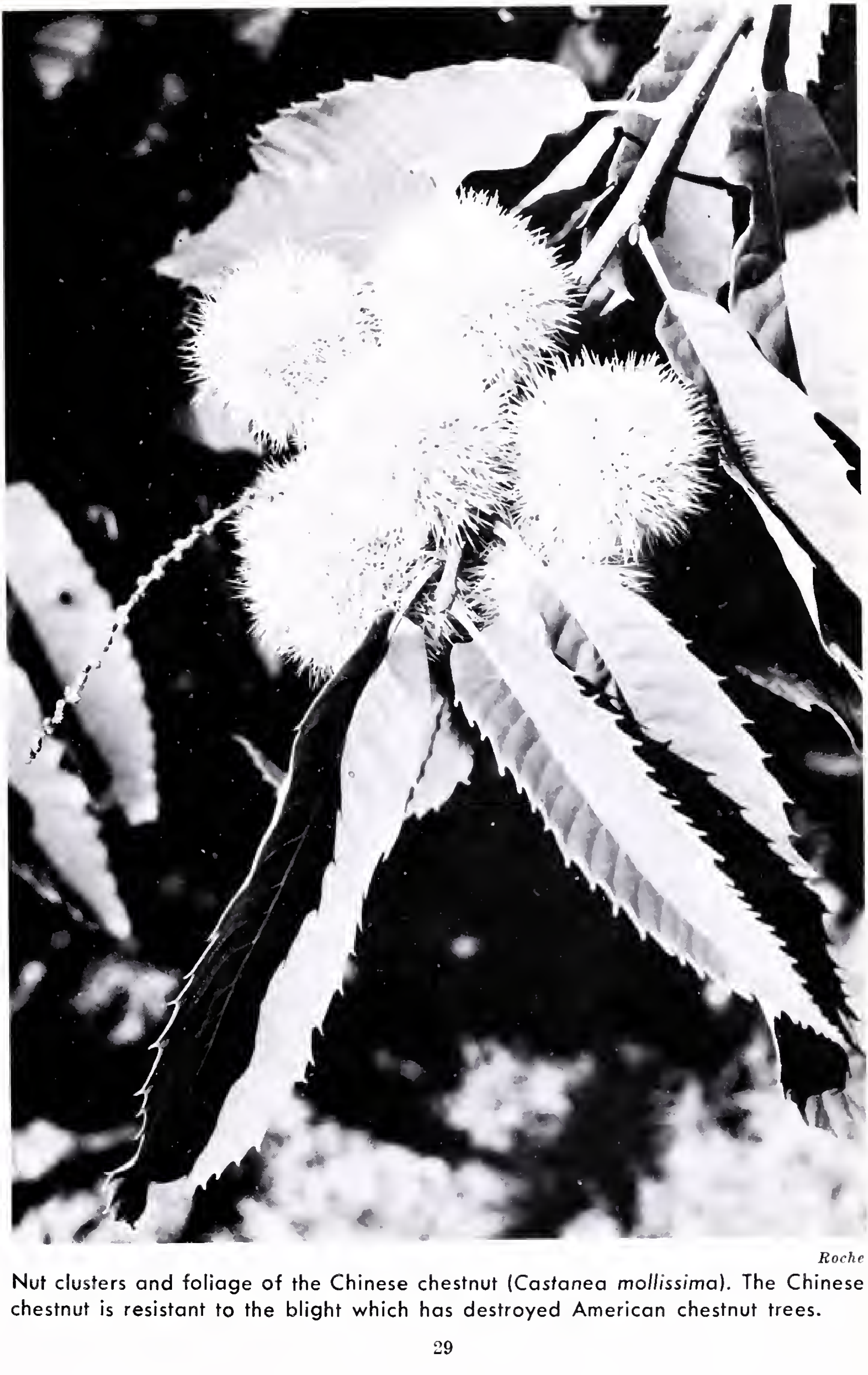
Nut trees thrive in deep, friable soil that would be rated as good agricultural land. Good drainage is essential and sandy or gravelly loams are better than light clay. In planting, an important consideration is to tamp the soil firmly around the roots. After planting, liberal watering is necessary and for the first year or two water must be supplied if the soil gets dry. Grass and weeds should be kept away from the trees by cultivation or with herbicides until they become established, then a mulch of straw or other litter is advisable. Nut trees, particularly when young, respond to nitrogen fertilizer applied in the early spring.

Nut trees have their share of diseases and insect pests. In many situations there is also competition for the crop from squirrels, crows and jays. In any commercial venture these must be controlled. In home plantings, spraying large trees is usually not feasible. In most years, however, it is possible to save enough of the crop to warrant growing the trees.

Harvesting

Nuts of all kinds should be harvested as soon as they are ripe and the husks removed promptly. Shaking or jarring the trees and branches may be necessary. Nuts left on the ground for even a short time may become infested with molds or are carried away by rodents. After husking, walnuts are improved in appearance and quality by washing with water. All nuts except chestnuts should be spread out in thin layers in a well ventilated place to dry. When the kernels are so dry that they break with a "snap" between the fingers, they are dry enough to be placed in bags or baskets and stored in a cool, dry place. Chestnuts, however, should be dried very little, then placed in polyethylene sacks in quantities of a few quarts or less and stored at 32°F. Fair success is had storing in the home refrigerator at 45°F., though the nuts will not keep as long at this temperature. The bags should have a few small holes made in them for ventilation.

This is a very brief and incomplete story of nut growing for the home gardener. Additional information may be secured from the Northern Nut Growers Association, 4518 Holston Hills Rd., Knoxville, Tennessee 37914. The Association has published a *Handbook of North American Nut Trees* (1969, $7.50 by mail). Agricultural experiment stations can often supply information on suitable varieties for their states. Cornell University Extension Bulletin 701 is very useful for the northern states. ◆



Roche

Nut clusters and foliage of the Chinese chestnut (*Castanea mollissima*). The Chinese chestnut is resistant to the blight which has destroyed American chestnut trees.

FRUITS—OUT OF THE ORDINARY

George L. Slate

THERE are many edible fruits of little or no commercial value which can be grown in the temperate zone to add interest and variety to the home fruit garden. Some are useful for eating out of hand while others are chiefly useful in cooking. Several withstand the severe winters and hot dry summers of the Great Plains, where early settlers made good use of them as there were few other fruits available.

These minor fruits are interesting novelties and they are often little troubled by insects and diseases. Some are not improved much from their wild state, but a few have been improved by breeding and interested persons have located and propagated superior wild types.

The native or common persimmon (*Diospyros virginiana*) is an attractive tree that grows to 50 feet in height in the open, where it makes a narrow, round-topped tree with dark green lustrous leaves. The fruit varies considerably in size, color, flavor, and time of ripening. The largest are about 2 inches in diameter and the color is usually yellow or orange, often with a reddish cheek. Inferior types and fruits not fully ripe are very astringent, but in the better varieties the astringency disappears when the fruit is ripe. Only the earliest varieties will ripen as far north as Geneva, New York, but several good ones usually mature before severe weather arrives. 'Garrettson,' the best variety tested by the writer, ripens in mid-October and remains in edible condition until Thanksgiving. Freezing will ruin immature fruits, but when fully ripe the fruit is not spoiled by the temperatures that usually occur before Thanksgiving. 'Early Golden' and 'Killen' are also good sorts.

The persimmon is dioecious, that is, the male and female flowers are borne on separate plants. Hence a male tree must be in every planting to provide pollen for the female flowers. If one is clever with the grafting knife, part of a male tree may be grafted to a female tree of a good variety, as only a branch or two is needed to provide pollen.

The papaw (*Asimina triloba*) is the only member of the Annonaceae, the custard-apple family, which is hardy in the northern United States. It ranges from Lake Ontario to the Gulf of Mexico, usually being found on rich bottom lands. The tree grows from 10 to 15 feet in height and has large glossy leaves, 6 to 8 inches long, which give the plant a tropical appearance unlike other small trees that grow in the northern states.

The fruits are 4 to 6 inches long, yellowish in color, with a sweet, richly flavored, highly perfumed edible pulp in which are embedded numerous brown seeds as large as lima beans. Only the earliest ripen in Geneva before frost. No named varieties are available from nurseries so one will have to locate seeds of superior early ripening types and grow his own. (See "Hunting For Better Paw Paws" by Corwin Davis, PLANTS & GARDENS, Winter, 1970-71.) The trees transplant with difficulty, hence only small seedlings should be planted.

Lesser-known Cherries

The genus *Prunus*, which includes peaches, plums, and cherries, has several less important species that are occasionally cultivated for their edible fruits.

The Western sand cherry (*Prunus besseyi*), a native of the Great Plains region is a low shrub, 3 to 4 feet high, that is attractive in foliage, and is a mass of white when in bloom. It bears early and heavily. In the humid East the fruit and twigs are sometimes injured by brown rot. Great Plains horticulturists have improved the sand cherry by breeding so the best named varieties are much superior in fruit character to the bush cherries often sold by nurseries, which produce harsh, astringent fruits of little

Right: The snowy flower clusters of beach plum (*Prunus maritima*), a familiar sight in late spring along the eastern seacoast. *Below:* The blue-purple fruits of the beach plum vary, but are usually about the size of large marbles. In the New York City area, they ripen during the first weeks of September.

George Taloumis

Paris Trail for the N. Y. S. Agric. Exp. Station

All photographs by Paris Trail

Fruits of the American persimmon.

The high-bush cranberry (*Viburnum trilobum*) bears large clusters of red fruits, about the same size as cranberries.

use except for jelly. The best varieties are 'Black Beauty,' 'Brooks,' and 'Sioux,' and even these are far inferior to the sweet and sour cherry varieties. However, sand cherries may be grown where their better relatives are not winter hardy, and the fruits add interest and variety.

The Beach Plum

The beach plum (*Prunus maritima*) of the sand dunes of the Atlantic Coast is prized as a jelly fruit, but is not of much use for eating fresh. Superior wild types have been discovered and named, but are not generally available. Beach plums are a good ornamental for sandy seashore gardens as they are tolerant of salt spray and attractive in bloom, as well as producing usable fruit. The plants grow from a few to 10 feet in height. They are often the most prominent woody plants in dune areas, thriving for years half submerged in the sand.

Nanking cherry (*Prunus tomentosa*), a dwarf cherry from northern China, grows 6 to 8 feet tall and bears a mass of white flowers very early in the spring, followed by a crop of bright red cherries with a pleasant and refreshing flavor. It is well worth growing as an ornamental.

Korean cherry (*Prunus japonica*) grows to 4 feet and bears heavy crops of cherry-like fruits that are about the size of sour cherries and much firmer. Many of the seedlings produce sour and astringent fruits, but some are of good quality and make good pies.

The high-bush cranberry (*Viburnum trilobum*) is a strong-growing native shrub bearing large clusters of red fruits, about the size of cranberries, that may be used for jelly. The plants are very hardy and grow up to 12 feet in height. Selected varieties have been named, but are not available from nurseries.

Juneberry (*Amelanchier alnifolia*), a Great Plains native, was popular with the early settlers and the Indians. The plants grow about 3 feet tall and bear heavy crops of berries that ripen near the end of the strawberry season and bear a superficial resemblance to blueberries. They are useful for pies but lemon juice should be added as the berries are mild-flavored. Birds are very fond of them and will take the crop unless the bushes are covered.

Elderberry

American elder or elderberry (*Sambucus canadensis*) is a useful pie and jelly fruit, and traditionally has been made into wine, both the flowers and fruits being used to make either a white or red wine. The variety 'Adams' is somewhat more productive than the general run of wild bushes. Some breeding work is being done to improve elderberry for commercial planting. More than one clone should be planted to provide cross pollination unless wild plants are nearby.

The Quince

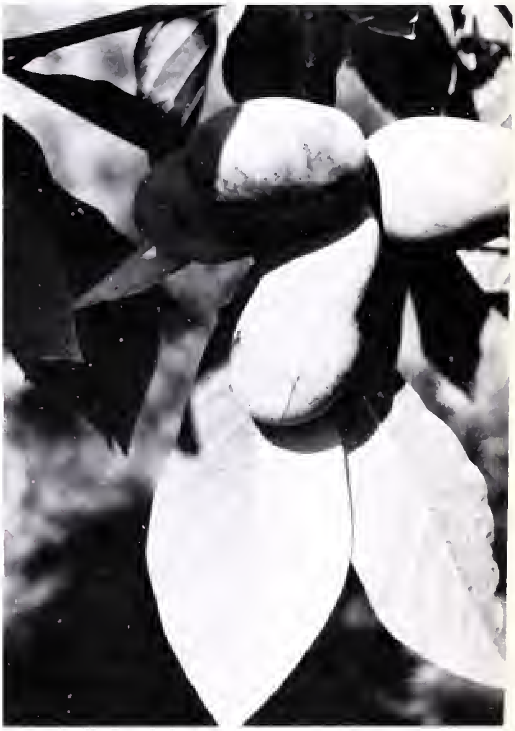
The quince (*Cydonia oblonga*) produces large golden fruits that are not edible raw, but make a delicious jelly and conserve. The trees grow 10 to 12 feet tall and are attractive in bloom. They are susceptible to fire blight and should not be grown too vigorously. Spraying for the oriental fruit moth is necessary.

Actinidia (*A. arguta*) is a handsome vine producing greenish yellow fruits, about an inch long, that are pleasant to eat and make an excellent conserve.

Mulberries (*Morus* spp.) have long been a dooryard tree. The fruit ripens over a period of several weeks and is beloved by the birds. Good varieties true to name are hard to get, but 'New American' and 'Downing' are old varieties with a good reputation. They should not be planted near the house or a side-walk as the juicy fruits are messy and stain clothing.

The buffalo-berry (*Shepherdia argentia*), another Great Plains native, produces small red, acid, but pleasantly flavored fruits on thorny shrubs that grow from 5 to 20 feet in height. The berries make good jelly and the silvery foliage makes the plant an attractive ornamental. ◆

The dark purple fruits of elderberry (*Sambucus canadensis*) are borne in large flat clusters and ripen in midsummer. They are used in wine or jelly.



Fruits of the papaw (*Asimina triloba*) are from 4 to 6 inches long. The edible portion is the sweet inner pulp.

HOME FRUIT GARDENING IN THE WEST

Reid M. Brooks and Claron O. Hesse

THE Pacific Coast States, and California in particular, are a mecca for home fruit growers. Mild climatic conditions mean that a great variety of fruits and nuts may be grown to perfection. Some 50 such crops are found in the West, old stand-bys such as apples, pears, peaches, grapes and plums, to such exotic items as dates, filberts, guavas, olives, and tangelos.

Thus some variety of most of our deciduous fruit trees can be grown almost anywhere in the West except in the high mountains where winters are severe. Most evergreens, such as citrus, may require special climatic conditions.

Fruits are available which require little or no care; others demand more than average care to yield good, healthy crops. In the first group are such fruits as blueberry, carissa, feijoa, fig, jujube, olive, pecan, persimmon, pistachio, pomegranate, and quince. These can be left alone but improved quality and production will result from greater care.

Some fruits demand an annual pruning and spraying schedule. Among these are apple, blackberry, cherimoya, currant, date, fig, ('Calimyrna' variety), gooseberry, grape, nectarine, peach, pear, raspberry, and strawberry.

Other fruits require average care, consisting of some pruning and spraying. Among these are almond, apricot, avocado, cherry, crabapple, filbert, grapefruit, guava, kumquat, lemon, mandarin orange, passion fruit, plum, tangelo, English walnut, and white sapote.

Even the smallest garden has room for some fruit plants—a bush or a vine if it will not accommodate a tree. Several kinds of dwarf trees are now available which will produce ample fruit for a family. By topworking, you may have more than one variety of a single kind of fruit on one tree, such as an early- and a late-ripening apple; or have peaches, nectarines, and almonds; or oranges and lemons.

Several conditions and cultural practices prevail in the West with which eastern gardeners are not usually concerned to so great a degree. Apart from winter hardiness and winter injury to plants, an important climatic factor in growing deciduous fruit trees in the West is their need for winter chilling. Lack of sufficient chilling results in irregular growth of buds; new foliage may not develop until some weeks after the normal time; flowering is irregular and long. Together these are known as *delayed foliation,* a condition especially prevalent in southern California. Lack of sufficient winter chilling may cause dropping of the fruit buds of apricot and peach just before flowering time. Varieties with low chilling requirement are recommended for areas of mild winter temperatures, and are specifically mentioned in the discussion of kinds of fruits following.

Frost Damage

Frost damage is important in the spring, but it also may occur in early fall at temperatures much higher than plants will withstand in midwinter. In spring, frost damage more commonly occurs as trees start to grow. Flower buds become more susceptible to frost damage as they open, and young fruits are more susceptible than flowers in full bloom.

Evergreen trees also suffer from frost damage, often in midwinter in areas

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Source of material: "Western Fruit Gardening" by Brooks and Hesse. University of California Press, 1953. Revised for this Handbook by Dr. Hesse.

where they are widely grown. Extensive damage is called winter injury. The gardener may not mind losing an occasional crop to frost for the pleasure of growing a species somewhat outside its recommended zone. To do so, protected sites may be used. Espaliered, dwarf, or tubbed plants may be effectively protected by covering them.

Irrigation

Irrigation must be used in the West because rains are so seasonal, particularly in California where it might not rain from May to December. As a general rule, if the winter rains have not wet the soil to a depth of about 6 feet, or to the full depth of shallower soils (at least as far down as the roots are growing) the deficiency should be made up by an early spring irrigation.

Young trees must be adequately watered the first season after planting. Frequent light irrigations are needed rather than a lot of water applied at long intervals. In dry areas, trees should not be planted unless they can be watered at least three times a year: first in March or April, if there has been deficient rainfall, or in June, if rainfall has been normal, and then at monthly intervals, preferably until October. Soil moisture must be maintained at all times; otherwise, fruit will be small and of poor quality.

To insure getting the varieties of your choice, order plants from your nurseryman as early in autumn as possible. In Washington and Oregon fall planting is often recommended and nursery plants are usually available then. In California and Arizona deciduous trees are more likely to be planted in January and February.

Some Western Fruits

Almonds do best in California's San Joaquin and Sacramento Valleys, and similar areas where warm, dry summers allow the nuts to ripen. Almonds bloom very early (February).

Paris Trail for N. Y. S. Agric. Exp. Station

A lack of sufficient winter chilling may cause apricot fruit buds to drop.

Varieties range from paper-shell ('Nonpareil'), through soft-shell 'Jordanolo,' 'IXL,' 'Ne Plus Ultra,' 'Eureka') to semi-hard-shelled nuts ('Mission'). All varieties are unfruitful to their own pollen, and thus pollen from another variety must be used to produce fruit. Plant trees of two varieties, or graft one variety onto a tree of a different variety. 'Ne Plus Ultra' or 'Peerless' and 'Mission' may be grafted onto the popular 'Nonpareil' to insure overlap of bloom. 'Karpareil,' which is similar to 'Nonpareil' may be used.

Apples are the most widely adapted of all the temperate-zone deciduous fruits. Varieties are available which do well in almost all the climatic regions of the Western states—except the low desert areas of California and Arizona. Ideal growing conditions are found in eastern Washington, western Washington and Oregon, the coastal districts of central and northern California, and some mountain valleys in central California.

The apple has a high chilling requirement but some varieties are available which need little winter chilling ('Beverly Hills,' 'Delicious,' 'White Pearmanin,' 'Winter Banana') and thus are suitable

Blackberries thrive in the West where summers are cool and fairly humid.

for southern California. Otherwise, the choice of a variety for your own garden is largely a matter of personal preference.

Semi-dwarf to dwarf trees may be propagated by using particular rootstocks. From most to least dwarfing are 'Malling IX,' 'Malling 26,' 'Malling VII,' 'Merton Malling III,' and "Merton Malling 104.' (See article on p. 9). Spur-bearing varieties, such as 'Redspur Delicious' or 'Goldspur Delicious,' are naturally dwarfed (approximately one-third), precocious-bearing selections of these popular standard varieties.

Apricots can be grown throughout the West except at high altitudes or in areas where late spring frosts destroy flowers or young fruits, as trees bloom very early (but after almonds). Best areas are the coastal valleys of central California near San Francisco Bay, and eastern Washington. The apricot's chilling requirement is very similar to the peach's. 'Royal' or 'Blenheim,' 'Tilton,' 'Wenatchee,' 'Earliril' and 'Blenril' are varieties of merit.

Seedlings of the Western sand cherry (*Prunus besseyi*) used as rootstock produce semi-dwarf apricot trees.

Avocados grow best in areas where the temperature does not fall much below freezing, thus limiting their culture almost entirely to southern California and a few areas in Arizona. Varietal quality is based on per cent oil content—the higher, the better the variety—and not on appearance, shape, or color. 'Fuerte,' which ripens during the fall-to-spring season, and 'Hass,' which ripens during the summer, are varieties of merit in nearly frost-free areas. 'Bacon,' 'Zutano' or 'Mexicola' are preferred in colder locations, being less frost-tender.

Blackberries include trailing blackberries and dewberries, and the upright or bush forms. They do best in regions with cool, fairly humid summer climates. Most varieties are susceptible to winter injury, and in areas where summer day temperatures are very high the vines do poorly. 'Boysen' is a favorite because of superior quality and high yields. 'Ollalie' and 'Marion' are newer varieties of considerable merit. 'Logan' and 'Thornless Logan' are more tart than others and so are good for baking and processing. 'Young' and 'Thornless Young' are like 'Boysen' but do not produce as well. 'Evergreen' and 'Olympic' do best only in western Washington and Oregon as do the upright varieties 'Eldorado,' 'Mersereau,' and 'Snyder.'

Blueberry culture is limited by soil and climate, requiring a cool summer for best development, and succeeding best in western Washington. Blueberries are adapted to many types of acid soil. They are reasonably free of disease and pest troubles, have a fine growing habit, and make good ornamentals as well as supplying the gardener with satisfying fruit. The newer varieties, 'Earliblue,' 'Bluecrop,' 'Ivanhoe,' and 'Berkeley' are superior to the older ones.

Carissa or **Natal-plum** is a medium-sized, evergreen shrub from South Africa, with scented white flowers which produce red fruits. Grow in temperatures above 26°F. Plants are very free from diseases and insects.

Cherimoya bears a custard-like fruit which is grown in mild subtropical regions, but does not do well where the summers are hot or the winters frosty. Individual fruits may average 1½ pounds each. Diseases and pests are not yet found on cherimoya in California.

Cherries—sweet, sour, Duke, flowering—all do well in the West. Sweets like an intermediate climate, as found in the valleys of eastern Washington, the river valleys of Oregon, in areas around San Francisco Bay in California, and in foot-hill areas (up to 3,000 feet) of the hot interior valleys of California. They are not as hardy as most other stone fruits.

Sweet cherries have red to dark purple flesh, as found in 'Early Burlat,' 'Moreau,' 'Black Tartarian,' 'Bing,' 'Lambert,' 'Van,' or cream-colored flesh as in 'Napoleon' ('Royal Ann'). Sweets are self-unfruitful, thus require cross-pollination; moreover, 'Bing,' 'Napoleon,' and 'Lambert' are inter-unfruitful and therefore with these some other variety must be planted (*e.g.,* 'Black Tartarian,' 'Van').

Sour, pie, or red cherries form an ideal garden tree, being easy to grow and not as large as true sweet cherry. They will withstand a more rigorous climate than sweets. Good varieties are 'Montmorency' and 'Early Richmond.' Duke cherries are hybrids between sweets and sours, with the color and shape of sweets and the tartness of the sour.

Cherries are susceptible to many diseases and pests. Perhaps the most serious trouble is bacterial canker, for which there is still no adequate control. Brown rot of flowers and fruits proves troublesome in humid areas, but may be controlled by sprays or dusts. The cherry fruit fly occurs in the Northwest. Viruses may be present in any cherry, so be sure to start with healthy plants.

Chestnuts make wonderful shade trees, and the nuts are good. They do well in cool climates, especially in the Northwest and in the California foothills up to 3,500 feet. They are winter hardy. Two kinds are available, Chinese and European varieties.

Sweet cherry trees thrive in intermediate climates, neither too cold nor too hot.

Crab-apples are eaten fresh or made into pickles or jelly. A rule of thumb makes all apples with fruits 2 inches or less in diameter crab-apples. Their climatic range exceeds that of standard apple varieties. Fruit colors vary from pure yellow to pure red. The trees are usually small, up to 20 feet.

Currants are easily grown, extremely hardy, and do best in a cool, humid climate such as that of western Oregon and Washington and along California's central and north coasts. Good varieties are 'Cherry,' 'Fay,' 'Red Lake,' and 'Perfection.' In pruning, do not save canes four years old or older as they are less fruitful; the best fruit comes from two-year-old canes.

Dates have been cultivated for thousands of years. The fruit clusters arise at a greater height from the ground each succeeding year, finally reaching a height of 75 feet or more. Long, hot summers, as found in the low desert valleys of California and Arizona, are required to mature the fruit. The tree will grow well in milder climates, as far north as Central California. The date is dioecious (see Pistachio), and pollina-

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The fruits of the gooseberry are used in pies, tarts and as preserves. The plants are not suitable for growing in the state of California.

tion is usually done by hand where fruit is to be produced.

Feijoa fruits have a somewhat tart flavor, suggestive of pineapples. The shrubs will grow to 15 feet or more but may be kept easily at 10 feet or less by pruning. Fine marmalades, jams, and jellies may be made from the fruits, or they may be eaten fresh by first removing the outer skin. The inch-wide flowers produce purplish white, fleshy petals which are good in salads. A subtropical fruit, it prefers cooler climates, doing well in northern California. The feijoa can be grown where winter temperatures do not drop below 12 to 15°F.

Figs produce two crops each year, the first ripening in early summer, and the second in the fall. Trees will grow to tremendous proportions—90 feet spread if allowed to do so; or, they may be kept small—5 feet—by judicious pruning. Cultural requirements are few.

The 'Mission' variety is excellent, even though black-skinned; it is suitable fresh, dried, and for jams. The second crop of 'Calimyrna' yields large, lemon-yellow fruits with amber pulp. 'Kadota' is mostly canned or dried, 'Turkey' is used fresh, while 'Adriatic' is usually dried. 'Calimyrna' requires cross-pollination with the caprifig (male), a procedure called caprification; it is accomplished by the presence of a wasp. The other varieties need no pollination to produce fruit.

Figs are propagated by cuttings. Few insects and diseases attack the trees.

Filberts, sometimes called hazelnuts, grow and bear well in western Oregon and Washington, but do not bear well in California. The two important varieties are 'Barcelona' and 'Du Chilly,' and they need cross-pollination. Except for filbert blight in the Northwest, filbert troubles are minor.

Gooseberry pies, jelly, preserves, and marmalades are excellent because the fruit is tart and pleasing, rich in acid and pectin. 'Oregon Champion' is recommended. No gooseberry is well adapted to California.

Grapes are grown by the gardener for table use, for their sweet, unfermented juice, and sometimes for canning and drying. Winemaking is not discussed here. In the Northwest or a coastal area, choose the earliest-ripening European varieties so they will mature before adverse weather arrives in the fall. Most European table grapes can be grown in the hotter interior valleys. American grape varieties do best in a more humid area, and approach their highest quality in the Northwest. In California, the coastal valleys are best for these.

The common table grapes grown in California are the European species, producing many varieties suitable for eating fresh, for canning, and for making grape juice. Native American species and their hybrids with Europeans are called slipskin grapes because the skin slips easily from the pulp. American varieties are more common in the Northwest where they are used for grape juice, although they are liked fresh because of their foxy flavor.

'Pearl of Csaba' has a muscat flavor, is nearly seedless, and does well in the Northwest. 'Delight' is the first truly muscat-flavored seedless grape developed. 'Thompson Seedless' is the most popular grape for eating fresh because it is seedless and sweet. 'Ribier' is a beautiful black table grape. 'Scarlet' is a black, with bright-red, sweet juice, having a mild 'Concord'-type flavor, and is recommended for a arbor. Other varieties suitable for the home garden are 'Monukka,' 'Red Malaga,' 'Flame Tokay,' 'Muscat of Alexandria,' and 'Muscat Hamburg.'

American and hybrid varieties are adapted to cooler regions than European grapes, and can withstand more humid climates. In approximate order of ripening from late July through October are 'Early Giant,' 'Portland,' 'Campbell's Early' (for the Northwest), 'Fredonia,' 'Worden,' 'Niagara,' 'Seneca,' 'Concord,' 'Delaware,' and 'Keuka.'

Grapefruit does best in the desert regions, especially of Arizona; in California it does well in the warmer inland areas of the south coast. Temperature influences the flavor during the growing season far more than it does that of orange. 'Marsh' is a fine, large, juicy, highly flavored, usually seedless variety. 'Ruby' is seedless with red flesh. For other remarks, please see Orange.

Paris Trail

American and hybrid grape varieties are adapted to cool and humid climates.

Guavas, Cattley, or strawberry guava, and common or lemon guava, have a high vitamin C content and make a musky but pleasant jelly. They are also eaten fresh. The large evergreen bushes may reach 20 feet if not pruned much. Cattleys do well wherever lemons are grown, while the common guava is more tender and likes protected places. They are remarkably free of insect pests and diseases.

Jujubes, sometimes called Chinese dates, have mild, quite sweetish, crisp flesh, but they are usually candied or glacéed, dried or canned. The trees are well adapted to California's hot valleys and any desert region. They are highly ornamental, with small, shiny green leaves and zig-zag twigs. The fairly winter-hardy trees appear to be free of all pests and diseases.

Kumquats, spicy, small citrus fruit, mildly acid, can be eaten in entirety, both rind and flesh. The trees are among the hardiest of citrus, doing well in California and Arizona (except in the mountains), and with proper protection in much of the Pacific Northwest. They grow only to about 10 feet. On trifoliate orange rootstock a dwarf tree, 2 to 4 feet tall, is produced and thus may even be grown in large pots or tubs.

Lemons are less tolerant of cold than orange. Trees of some varieties, *e.g.*, 'Meyer,' are small and the fruit is a little less acid than true lemons such as

Fruits of the jujube are borne on a small tree, often grown as an ornamental.

'Eureka' or 'Lisbon,' which grow on large trees.

Limes, a highly flavored acid fruit, are very sensitive to cold, so should not be attempted where temperatures fall below 28°F. Some lime-like fruits, such as Rangpur, are good substitutes as they withstand lower temperatures. Limequats and calomondia are good, too, and less sensitive to cold than are limes.

Loquats are long-lived evergreens, producing yellow egg-shaped fruits in the springtime. The tree is usually about 20 feet tall but can be double that height. Leaves are long, up to one foot, and 3 inches wide. Loquats can be grown almost anywhere in California. Because blooms appear in the winter, it is not suitable to high elevations or the Northwest.

Macadamias produce a fine nut, high in oil but encased in an extremely hard shell. A native of Australia, it is relatively new to the Pacific Coast. Being sensitive to cold, plantings should be limited to nearly frost-free areas, as lemons are.The tree is slow-growing and reaches a height of about 30 feet.

Mandarins are loose-skinned oranges, sometimes called tangerines. Trees are very cold-resistant, but the fruits are as sensitive as sweet oranges. Good quality fruits require a warmer summer than oranges. 'Dancy' (Dancy tangerine) is the best known mandarin. 'Owari' ('Owari Satsuma') is not as sweet as 'Dancy' but is recommended for northern California. Newer varieties are 'Kara,' 'Kinnow,' 'Frua,' 'Fremont' and 'Pixie.' Mandarin varieties ripen from early winter to late spring.

Nectarines are smooth-skinned peaches. Trees are identical to peach trees but the fruits are usually smaller, sweeter, and with a distinct aroma. There are clingstone and freestone, yellow- and white-fleshed nectarines. Varieties may be selected which ripen from the first week of June through the first of September. Among them are 'Sunrise,' 'John Rivers,' 'Independence,' 'Sun Grand,' 'Early Flame,' 'Star Grand,' 'Stanwick,' 'Grandeur,' 'Red Grand,' 'Le Grand,' 'Flavorop,' 'Fantasia' and 'Late Le Grand.' For mild winter climates, 'Arm King,' 'Panamint,' 'Silver Lode,' and 'Pioneer' do best. 'Pioneer,' 'Freedom,' 'Garden State,' 'Stanwick,' 'Tiova,' and 'Victoria.' Culture and climate are identical to those of peach.

Olives are adapted to California's hot interior valleys and deserts. This evergreen has feathery, grayish foliage. It is a graceful ornamental as well as an important pomological species. Fruits are used for pickles, never eaten fresh, and the higher the oil content, the better the fruit. Heating ripe processed olives before serving brings out the flavor.

Oranges are of three types: common fruits ('Valencia' and 'Trovita' varieties), navel fruits ('Washington,' 'Robertson'), and blood fruit ('Ruby,' 'Torocco'), having red pulp and juice. These ripen throughout the year: for example, 'Valencia' in summer, 'Washington' in winter, 'Ruby' in late winter or early spring. Sweet oranges set the standard of comparison of cold resistance for citrus. Mature, vigorous orange trees will withstand temperatures down to about 15°F., which sets their cultural limit. Since oranges bloom for a long time, spring frosts are not too serious. As fruit is on the tree during winter, it is more susceptible to frost damage than flowers or branches.

Trifoliate orange seedlings are used as

a rootstock to dwarf **citrus** varieties. Citrus are sensitive to wet soils yet need frequent waterings. Thus the soil should drain rapidly. Trees require nitrogen but no other fertilizer. However, some California soils lack sufficient potassium and if symptoms of deficiency are present—weak growth, small fruit, puckered and lusterless leaves—apply large amounts 10 to 15 pounds per tree) of potassium sulfate.

Not much pruning is required. As trees grow older, cut out crossing and interfering limbs. Trees tend to shape themselves. There are many pests and diseases, usually minor, quite a few physiological disorders, and few viruses.

Papaya fruits may be ripe eight months after the flowers bloom, and flowers bloom five months after planting seeds. The fruits are large, up to 5 pounds, having a succulent thick flesh. Since this is a tropical species, it may be grown only in the warmest frost-free areas, or in a greenhouse.

Passion-fruits are woody, evergreen, perennial vines which grow very rapidly; they are considered subtropical. The most familiar edible passion fruit is a purple one, sometimes called the purple granadilla. Fruits are about the size and shape of an agg, bearing many small seeds surrounded by juicy pulp—aromatic, of a different, pleasing, acid flavor—encased by a thin, hard rind. The flowers are exotic looking. There are no serious pests or diseases.

Peach is queen of the temperate-zone fruits, being the most widely grown tree fruit in the world, next to the apple. Its range is a little south of apple as it is less hardy than apple. Peaches grow well in clear, hot weather and thus do best in the West's hotter inland areas. In California they reach perfection in the hot interior valleys, and up to 2,000 feet in the foothills.

Peach trees are very attractive in bloom. They do not become very large, about 15 feet with a spread of about 18 feet. They start bearing good crops when 3 or 4 years old, reaching their peak at 8 to 12 years.

Peaches thrive in California's interior valleys and areas of similar climates.

There are freestones and clingstones, and yellow- and white-fleshed fruits. Most home gardeners prefer yellow-fleshed freestones. Varieties are legion, with new ones being introduced regularly. Here are some varieties (those for mild winter climates, as southern California, are marked *) arranged by ripening dates beginning the first week in June and ending in late September: 'Springtime,'* 'Armgold,'* 'Robin,'* 'Blazing Gold,' 'Cardinal,' 'Coronet,' 'Babcock,'* 'Regnia,' 'Redtop,' 'July Elberta,' 'Babcock,'* 'Suncrest,' 'Forty-niner,'* 'Fay Elberta,' 'Fayette,' 'Summerset,' and 'Ventura.'*

The popular varieties 'J. H. Hale' and 'Alamar' are pollen sterile and require a second variety, either planted nearby or topworked onto them, for fruit set. 'Altair'* and 'Saturn'* are dual-purpose varieties, adapted to warm winters, and bear ornamental flowers and edible fruit. 'Bonanza'* is a very dwarf variety of considerable ornamental value, which bears edible fruit.

Peaches are self-fruitful except for 'J. H. Hale' and 'Alamar,' which have no pollen. Fruits may set too heavily and therefore must be thinned in order to produce those with good size and quality. Thin when the fruit is about 1¼ inches in largest diameter, leaving one fruit every 6 to 10 inches along the branch.

Pears bear good quality fruit from midsummer until late fall. The popular 'Bartlett' comes first followed by many excellent varieties. 'Max Red Bartlett' is a red-skinned form of this popular variety. 'Seckel' ripens about a month after 'Bartlett' and is the variety par excellence for the garden, even though the fruit is small and somewhat unattractive. 'Dana Hovey,' 'Comice'—many consider this the best pear there is, 'Hardy,' 'Winter Nelis,' 'Bosc,' and 'Winter Bartlett' are other good later-ripening varieties for the West.

'Bartlett,' 'Comice,' and 'Hardy' are usually self-fruitful in California, but not in the Northwest.

Dwarf trees may be produced by budding to quince rootstock and pears for espaliering or planting in boxes should be on quince.

Pears are susceptible to fire blight. Some resistant but inedible varieties are available, *e.g.*, 'Old Home' and 'Farmingdale.' Bud these quince on root; allow them to produce main branches. At a distance of 18 to 24 inches from the trunk graft or bud the desired variety. If fire blight hits a branch, it will not destroy the entire tree. If planted deep, either 'Old Home' or 'Farmingdale' will usually produce its own roots; the quince will die, and therefore the entire trunk and roots will be resistant to fire blight.

Pears should be ripened off the tree, as tree-ripe fruit is inferior. Pick when green and hard, but of the size the given variety should be when ripe. Ripen in a cool place.

Pecans require long hot summers to fill the shell properly. They can be grown as shade trees in most areas, however, as they are resistant to low winter temperatures. The trees are graceful but extremely large, thus are not too well suited for the small home garden. In order to secure a long growing season to mature the nuts, select early-leafing varieties such as 'Select,' 'Nellis,' and 'Humble.' Other varieties, 'Mahan,' 'Success,' and 'Burkett,' are fairly well adapted to California. Trees need little if any pruning.

The fruits of the pear should be harvested when they reach full size but before they are fully ripe. They should then be allowed to ripen in a cool place.

Persimmons used in the West are the Oriental (Japanese or kaki) species, and they may be grown almost anywhere where temperatures do not go below 0°F. Their fruits are of two types, astringent and non-astringent. Astringent varieties ('Hachiya') pucker the mouth unless the fruit is extremely soft, when they have a rich flavor. Non-astringent varieties ('Fuyu') may be eaten firm ripe, like an apple, but their flavor is different from that of the Hachiyas. Persimmon is perhaps the best fruit for home planting if one wishes to give little or no care to the tree, yet have delicious fruit.

Pistachio nuts have a blush-pink shell surrounded by crisp flesh. To process, remove the covering, dip the hulled nuts in water, spread in the sun to dry and to split the shell; or, boil the nuts in a salt solution for a few minutes, then redry. The fairly large tree grows slowly, but can be kept small by pruning. It is as cold resistant as almond. Pistachios are dioecious, having male and female flowers on separate trees. In order to secure nuts, plant trees of both sexes, or graft scionwood of a male tree into a branch of the female variety. 'Kerman,' 'Red Aleppo' and 'Trabonella' are female varieties; 'Peters' is a male variety.

Plums are many, so that one or more should fit anyone's taste. European, blue, or common plums ripen during late summer and fall (*e.g.*, 'Tragedy,' 'Emilie,' 'Rayburn,' 'Italian,' 'President'). They do well in the Pacific Northwest and in California's central and northern coastal and interior valleys, and in mountains up to 2,000 feet.

Prunes are European plums which can be sun-dried without fermenting at the pit. (See Prune.)

Japanese or Oriental plums are usually red and bloom early ('Beauty,' 'Burmosa,' 'Santa Rosa,' 'Redheart,' 'Satsuma,' 'Duarte,' 'Red Rosa'). They do well in eastern Washington and Oregon valley sites but reach perfection in California's foothill and valley areas, and also do well in southern California at higher elevations. They do best with hot summer days. They make great shoot growth and must be pruned rather severely at all ages. They tend to overbear, and if they do they should be thinned by removing fruits from the tree as soon as they are easily seen, spacing the remaining ones 4 to 6 inches apart.

There are many American species of plums, native to the Southwest, the Pacific Coast mountains, and central Canada.

Damson plums are tart and are used for jams and jellies. They are more cold-resistant than Europeans.

Many ornamental plums are suitable as well for jellies and jams, and some are edible fresh ('Thundercloud,' 'Pissardi,' 'Hollywood').

Some varieties are inter-unfruitful; this means, *e.g.*, that 'Beauty' and 'Kelsey' or 'Beauty' and 'Burmosa' will not pollinate each other.

Pomegranates produce red round fruits 3 to 5 inches in diameter, bearing numerous seeds surrounded by a soft tissue which contains a sweet but astringent juice, all encased in a leathery shell. Pomegranates make either a bush or a small (10 feet) sturdy tree by appropriate pruning. They will stand temperatures to 10° to 15°F. and do well in the hot valleys of California and in the desert regions. Pomegranates can be grown with no attention.

Prunes are European plums which can be dried without fermenting at the pit, due to their very high sugar content. They may be eaten fresh but are very sweet. The most important commercial variety grown in California is 'French,' small and yellow-fleshed. 'Imperial' is very large; 'Sugar' is often sold fresh and may be canned. (See Plum.)

Quince fruits are fragrant, up to 5 inches in diameter, and are found on a small, twisted tree or shrub. It is well adapted to many regions, perhaps more so than any other fruit tree. 'Smyrna' is probably the best variety. Pests and diseases are not serious.

Raspberries do best in the Northwest, especially in the mountain valleys and western Washington and Oregon. The

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Nuts of the Persian or English walnut are borne on trees too large for the average home fruit garden or orchard.

best areas in California are in cool valleys of the north coast, but no variety is really adapted to the hot summers of Arizona and California. Under best conditions they produce fruit all summer, but usually have peak seasons in spring and fall.

Of the three kinds of raspberries, red, black, and purple, only the red varieties, 'Willamette' and 'Fairview' can be recommended for California. All kinds grow well in the Northwest. 'Bristol,' 'Munger,' and 'Plum Farmer' are among recommended black varieties for Oregon and Washington. 'Sodus' is the only purple raspberry recommended. It does well in eastern Washington and Oregon.

Strawberries can be grown nearly all over the West, but they require good care. They should never suffer from lack of water. Plant in soils with good drainage and with no high concentration of salts. 'Northwest' and other new varieties are recommended for the Northwest. In California 'Tioga', 'Sequoia', and 'Salinas' are better adapted to the climatic and soil conditions. Everbearing strawberries bloom and fruit during the entire growing season, but do not yield high crops at any one time. Among the everbearers are 'Rockhill' and 'Twentieth Century.'

Nearly all plants are propagated by runners, and will bear for 3 or 4 years, sometimes longer. They are planted either in raised beds which are irrigated by furrows between the beds, or in flat beds which must be sprinkler irrigated.

Tangelos are considered the best of all citrus fruits by some people. They are hybrids between mandarins and grapefruits. They are very tender, so cannot be shipped, and thus their main value is as a garden fruit. Some resemble oranges, other mandarins. Tangelos are similar to oranges in climatic requirements. 'Minneola,' 'Sampson,' and 'Pearl' are all good varieties, 'Minneola' being the best.

Walnuts are of two kinds: the more important species is the English or Persian walnut, with shells that are easy to crack and excellent meats used in many ways. The black walnuts produce hard-shelled nuts and small meats with a pronounced flavor. English walnut trees are 50 to 70 feet tall with an equal spread, so usually they are not planted by home gardeners. Black walnuts are more upright but not as good looking, and are not well suited for the garden. The northern limit of English walnuts is the low valleys of western Oregon and Washington; elsewhere, danger from frost is too great. In California they are grown in nearly every county. In mild climates, delayed foliation is a problem (see page 34). Unless they are shaded nuts will sunburn in temperatures above 105°F., and these fail to fill properly.

The 'Franquette' is excellent and about the only one recommended for the Northwest as it flowers late and the tree is resistant to cold. It will do well in California, as do 'Eureka,' 'Hartley,' 'Vina,' 'Serr' and 'Concord.' Suitable for southern California are 'Payne' and 'Placentia.'

Northern California black walnut seedlings are the usual rootstocks, being resistant to oak-root fungus.

White Sapotes are small to medium evergreen trees with large, five-fingered leaves. The soft-fleshed fruit is the size and shape of a small apple with a distinctive flavor. They are grown in nearly frost-free areas and are free from diseases and pests. 'Coleman,' 'Wilson,' and 'Pike' are good varieties. ◆

PRAIRIE HOME FRUIT GROWING

P. J. Peters

GROWING FRUITS in the home gardens in the northern prairies is a challenge. Severe climatic conditions and the brevity of the growing season of the region do not permit commercial fruit enterprises, which makes the challenge to the home gardener all the more enticing. The home gardener sets out to do what people say can't be done! The results can be exciting and gratifying; the many failures make the few successes all the sweeter. As a start, the home gardener is advised to buy varieties of tree and small fruits that are recommended for his area. Recommended variety lists may be obtained from Provincial Departments of Agriculture in Canada, or from state agricultural experiment stations in the United States.

Shelter

Most important for success with fruits in the home garden is the provision of shelter provided by trees and shrubs. The searing, dessicating winds of winter spell doom to fruit crops that would have succeeded if wind protection had been provided. What is the direction of the prevailing winds in winter? Once determined, a multi-row tree and shrub shelter belt with a row of evergreens planted on the inside should be provided on at least two sides of the garden to break the wind. Generally it is the north and west sides of the fruit garden which require this protection. A snow trap consisting of a row of willow, caragana or Siberian elm should be planted at least 100 feet away from the main shelter belt. This will prevent the build-up of huge snow drifts which can injure otherwise healthy fruit trees. Only single-row tree shelter should be provided on the south and east sides, as a solid shelter belt on all four sides of the garden may make it a hot box in summer.

Adequate and properly designed shelter provides the fruit garden with a microclimate all its own. It is the frame that enhances the beauty of a beautiful canvas—in this case—the fruit garden. It must be correlated with the house and its surrounding landscape to ensure a cohesive plan of both beauty and utility. Extension workers and county agents can help in designing shelter belts or at least direct the enquiring gardener to the right source for such information.

Soil

A friable, sandy loam of good drainage is best suited for the home orchard. If the site can slope down to the north or east, so much the better. The home gardener will have to work, however, with the soil available. Good management of even poorly adapted soils can often bring remarkable results.

Internal drainage is of the utmost importance. If internal drainage is poor, it may be advisable to construct a series of drainage ditches that will prevent water from standing in the garden so after a heavy rain it will not soak down and create waterlogged conditions.

The soils of the western plains are usually in the higher pH range, somewhere between 7.5 and 8.0 pH or even higher. The iron in the soil is there, but not in the form available to the plants. The result is that orchards often suffer from chlorosis. Observation of chlorotic apple trees and raspberries indicates that sulfur is the best means of rectifying or minimizing chlorosis. When apple trees are planted, holes three or four times as large as required are dug. About 3 pounds of powdered sulfur are incorporated into the soil that is returned to the hole when the tree is planted. Before raspberries are planted, about 10 pounds of sulfur are spread on a 50-foot by 2-foot row, which rototilled to a depth of about 8 inches. The past six years' results with sulfur applied before planting have been uniformly good.

(*Continued*)

Water

Most areas of the prairie region are deficient in rainfall and precipitation in general. Fruit trees and small fruit crops thrive on moisture. Irrigation is often the difference between failure and success. Trees have deep root systems and do best when they are watered so well that the root zone receives the necessary moisture. Fruit trees should be watered late in fall or early in winter so their soil enters winter fully saturated. The drying out and subsequent death of fruit trees is often the result of a tree entering winter dormancy with too little moisture.

Irrigation is also most important in preventing frost damage to fruit blossoms. Sprinkler irrigation can prevent frost damage to strawberry blossoms even when eight degrees of frost are experienced.

Stembuilder Trees

The trunk and the branches of a tree are quite susceptible to winter injury. By substituting the framework of a hardier variety, much of this injury can be prevented. The method of stembuilding involves the budding of the desirable variety on the framework of a hardy variety. The Canada Research Station at Morden, Manitoba has experimented with stembuilders for apple trees in the last decade or so. (Publication 460, entitled "Hardy Stembuilders for the Prairie Orchards" can be obtained from the Publications Branch, Room 713 Norquay Building, Winnipeg 1, Manitoba.) Manitoba is cooperating with several growers to establish stembuilder-apple orchards.

Strawberry Culture

Considerable work has been done on strawberry culture in Manitoba in the last few years during which time some 50 varieties have been tested. Most of these varieties have been June bearers. 'Redcoat,' a variety developed at the Experimental Farm in Ottawa, is our best current variety. 'Veestar' and 'Vibrant,' two new varieties developed at the Vineland Research Station at Vineland, Ontario, look promising, but fail to yield as well as 'Redcoat.'

Paying attention to the following has made it possible to establish a viable commercial strawberry industry in our Province: planting certified or virus-free stock; building shelter to encourage a uniform snow cover; using proper mulching materials; installing solid-set irrigation systems for both moisture and frost control.

Home gardeners who follow similar procedures are glowing with success! The variety 'Ogallala,' an everbearer, is a favorite in home gardens, but the berry is too soft for commercial purposes.

Tricks of the Trade

Pruning in the prairie orchard differs from that in orchards in less rigorous climates. Pruning should be done later in spring when frost injury to limbs of trees becomes evident. The injured branches are then removed and the rest of the pruning carried out after this. The modified leader system is best. Quite often Father Winter determines the shape of the tree.

Slightly thinned, white, interior latex paint, which is applied to the stems and major branches of fruit trees, helps greatly to reduce sun scald. The paint is applied by brush or sprayer on a warm day late in November.

A cheap grade of window screening can be used as a mouse guard around fruit trees. A common stapler is used to fasten a loose cylinder of screen around the bottom of a tree.

With the availability of soil-testing programs, fertilizer requirements of fruits can be more accurately determined. A moderate application of a high-nitrogen fertilizer containing sulfur will encourage better growth, especially in a cool, backward spring. Soil tests will indicate the nutrients available in the soil and take the guesswork out of this phase of fruit culture.

The fruit shows held in conjunction with other horticultural shows bear testimony to the fact that fruit of quality can be grown in the prairie regions. ◆

PRUNING FRUIT TREES, VINES AND BUSHES

J. R. Magness

TO MANY home gardeners pruning seems to be one of the most puzzling and difficult of cultural practices in growing fruits, but if certain basic principles are kept in mind it is possible for even inexperienced growers to do a satisfactory pruning job. The purpose of pruning is to develop the tree so it will have maximum strength for bearing and carrying a good crop of fruit. A safe rule to follow is to prune as little as necessary to accomplish this purpose.

When to Prune

Pruning of fruit trees in general should be done during the dormant season, preferably in spring after danger of severe frost is over but before growth has begun.

Pruning Young Trees

The first pruning should be done at the time the trees are planted. If they are just unbranched whips, this pruning consists simply of heading them back to a height of 3½ to 4 feet. If the trees are branched, certain of the branches are selected to be the framework of the tree; the others are removed. In general, the branches which are kept should point in different directions, and should be at least 6 inches apart along the trunk. Not more than three or four such branches should be left.

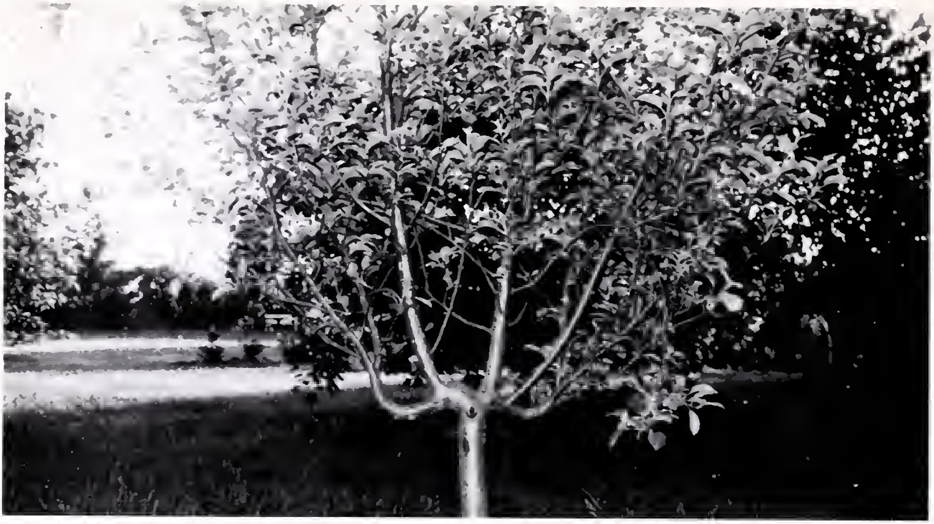
Peach trees are often well-branched when received from the nursery. Such trees are headed back to about 3 to 3½ feet and the side branches cut back to spurs, taking care that at least one well developed leaf bud is left on each spur. During the growing season these buds will produce branches, and from these are selected the framework branches, the others being removed. Pruning from this time until the tree comes into bearing will be mainly for purposes of training. As the tree develops and the branches increase in number and size a little corrective pruning is likely to be needed. Crowded limbs and parallel branches should be corrected by removing the less important branches. Occasionally a limb may outgrow the others and have to be cut back to keep the tree reasonably symmetrical, though very little heading back should be done until later in the life of the tree; and even then the heading back will probably be for the purpose of thinning the fruit or stimulating new growth at local points.

For fruit trees in general the topmost branch should be one making a somewhat stronger growth than any of the lower branches. If the branches are well spaced along the trunk, the trunk will be of a larger diameter than the branch which rises from it. Such a union between trunk and branch gives the strongest possible crotch.

After the second spring and until the trees are in bearing condition, pruning should consist simply of a light thinning-out each season. Overpruning of trees through this stage is far more serious than underpruning. If the trees are well shaped and the scaffold branches properly selected during the first two years, no great harm will result if little pruning is done during the years following, until the trees are well into bearing.

Pruning Bearing Trees

In general, peach trees require much heavier cutting than apple or pear trees if they are to be kept in satisfactory bearing condition. The fruit of peach trees is borne on the previous season's growth, and it is necessary that strong growth should develop each season to keep the trees in satisfactory producing



Robert F. Carlson

A 'Northern Spy' apple, budded on EM VII rootstock, has been trained in a fan shape. It can make an attractive screen to divide certain areas in a home garden.

condition. If too much bearing wood is left on trees during any season, the growth made the following season is reduced and production the next season thereafter will be correspondingly reduced. Therefore it is good practice to give peach trees a fairly heavy pruning each spring in order to maintain them in vigorous condition.

This pruning in peach trees should consist of thinning out shoots and heading back to reduce the fruit-bearing surface. Much thinning of the peach crop is done by pruning. Such pruning should be delayed until the condition of the buds can be determined in the spring. Frequently peach fruit buds are killed in part or entirely by low winter temperatures. If only a few buds are alive in the spring, little pruning should be done that year.

Apple and pear trees produce fruit primarily on spurs which may be on relatively old wood. Therefore the bearing surface does not need to be renewed each year, as with peaches. Consequently apple and pear trees require only a light annual pruning after they have come into bearing, in order to prevent the top from becoming too thick and bushy and to facilitate spraying and other orchard operations. If the pruning is done each year, it should consist only of a light thinning out, removing primarily the weakest-appearing or thinnest wood. A thorough pruning of bearing trees once in three or four years is usually ample, although a light pruning each year is preferable.

The shape that a tree will assume is determined largely by the characteristics of the variety. It is impossible to change these natural tendencies greatly by pruning treatments, and, in general, it should not be attempted. The tree should be given plenty of space to develop its natural form. The most important consideration in the whole life of a tree from the standpoint of pruning is to make the proper selection of branches spaced at considerable intervals up and down the trunk during the first year or two after the tree is planted. During the bearing life of the tree, pruning can be used to thin out the top and give better quality fruit with better color and size than results if the tree is unpruned. Overpruning, however, is always a more serious mistake than underpruning; throughout the life of an apple or pear tree cutting should be held to a minimum.

The pruning of cherry, plum, and apricot trees involves the same general principles as the pruning of apple and peach trees. The habit of fruiting of different kinds, and, to some extent, of different varieties, may in some cases determine the details of pruning. If a cherry tree is making a very strong annual growth, slight heading back will usually help to stimulate the development of fruit spurs.

The apricot produces most of its fruit on short lateral branches that develop from the older wood. Pruning with a view to the development of an abundance of these lateral shoots and the maintenance of their vigor becomes one of the essential features in the management of apricot trees. Under some growth conditions slight heading back of the annual growth or even cutting back the bearing lateral shoots will help to develop and maintain an abundance of bearing wood.

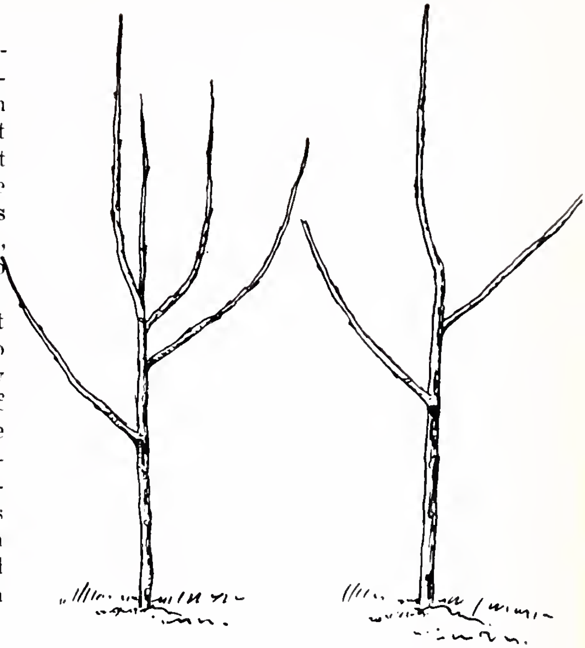
Pruning Grape Vines

At the time of planting, grape vines are usually cut back to one or two buds. If they make a very strong growth during the first season, this growth can be tied to a stake to form the trunk of the vine. If the growth is rather weak during the first season, it is preferable to cut back at the end of the first growing season again to one or two buds, and to train up a strong trunk during the second growing season.

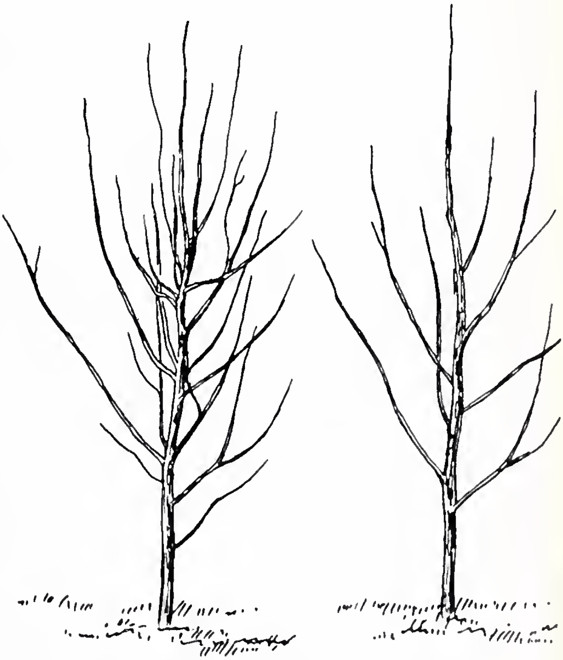
If the vine is to be trained to a fence or a 2-wire system, it should be tied to a stake and carried upright until it reaches the top wire. At that point it should be pinched off and two laterals led out, one in each direction, along the wire.

During the following season, lateral canes will grow from all the buds along the trunk. Two of these at the height of the first wire above the ground should be selected and tied to the wire to develop fruiting wood. The other branches along the trunk should be rubbed off or pinched back during the growing season.

After the vines attain this form, pruning will consist in saving one strong lateral and tying it along each wire each growing season. All other laterals will be



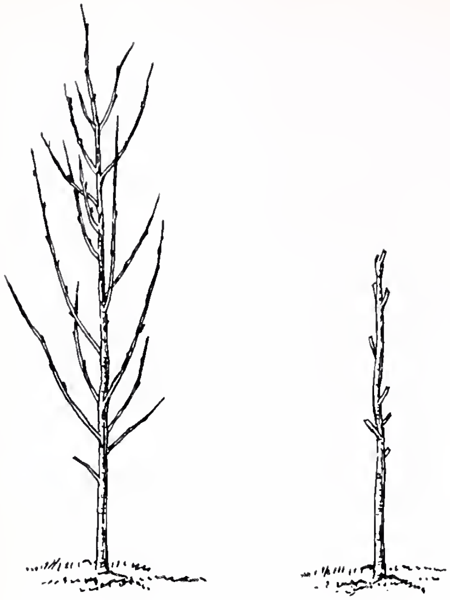
After planting, a multi-branched tree (*left*), is pruned to leave three or four scaffold branches (*right*).



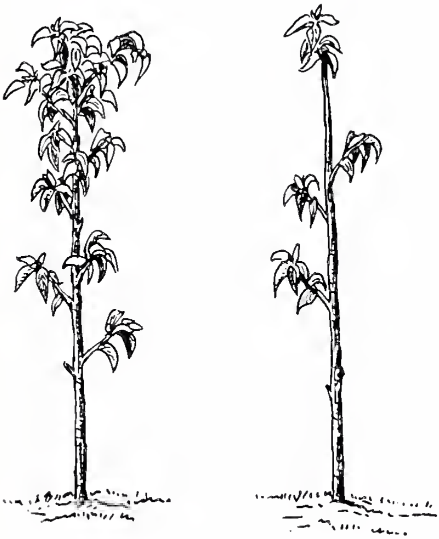
Apple tree after second season of growth (*left*) and after pruning (*right*).

removed except that short spurs should be left to grow the fruiting cane for the next season.

More wood may be left on vines for home production, provided sufficient space is available for the vine to develop. With vigorous vines, the leaving of more wood would result in a greater total quantity of fruit, although the individual bunches may be inferior in size and quality. The type of pruning outlined is essentially that followed in most commercial vineyards in the United States, except in California. For pruning of grapes in California, see page 53.



Well branched year-old peach tree as received from nursery (*left*) at planting time, and after it was pruned (*right*).



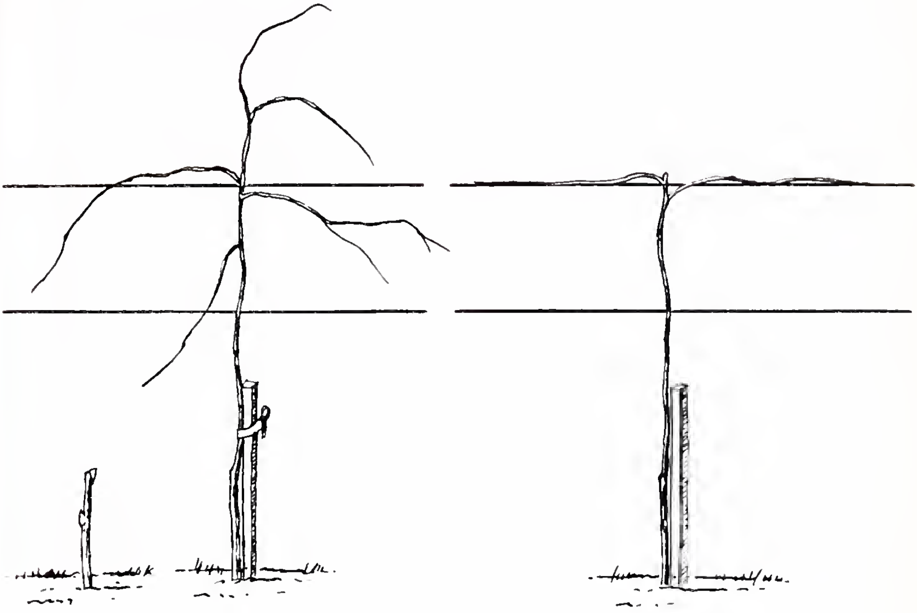
Same tree several weeks after it started growth (*left*), and after all branches except those selected for final framework of tree were cut off (*right*).

Raspberry and Blackberry Plants

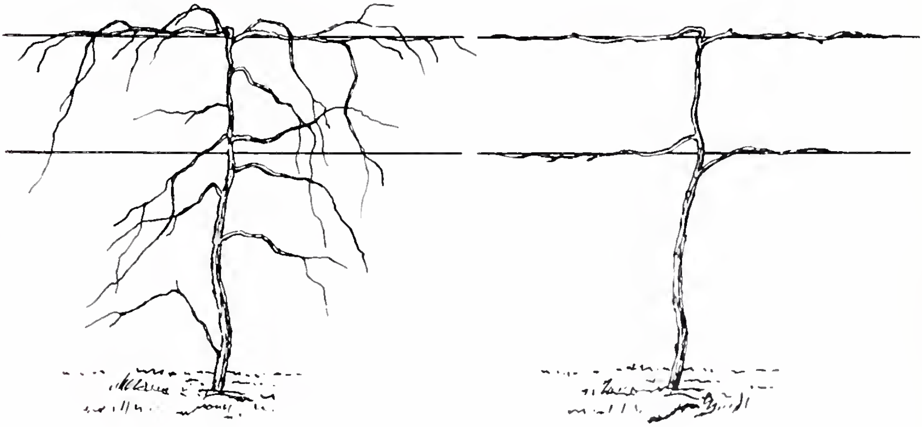
The pruning of raspberries and blackberries consists of removing the old fruiting wood each season. This wood may be removed immediately after the crop is harvested, or it may be left until the dormant season. In most parts of the United States it is preferable to remove the old wood immediately after fruit harvest, so as to prevent the crowding of the new canes by the old and to prevent the spread of disease from the old canes to the new ones. These old canes should be cut off close to the ground, and the new canes will then develop strong growth to produce fruit for the following season. With raspberries, both black and red, it is frequently desirable to tie the new canes, either between wires or to stakes, to support them off the ground. Blackberry and dewberry canes should also be tied to stakes or to a trellis, but canes of all varieties of bramble fruits, not completely hardy, may be left on the ground, where they will have some snow cover, or else will be covered with soil until spring. They should then be tied to stakes or to a trellis prior to the starting of growth in the spring. If raspberries and blackberries make a very strong growth and develop a large number of canes, it is frequently desirable to thin out the number of canes to six or eight per hill during the dormant season.

It is generally desirable to cut off the tips of the young shoots of black raspberries when they reach a height of 18 to 24

PRUNING GRAPE VINES



When planted, grape vines are pruned back to one or two buds (*left*). After vine develops first year (*center*), two branches are selected and trained to upper wire as shown at right.



During second year, the vine develops many branches (*left*). In addition to two laterals previously trained to the top wire, two more are selected and trained to the lower wire (*right*); the other branches are removed.

"Whips" are headed back when planted.

inches. This induces branching and results in more satisfactory total production. Red raspberries and blackberries usually are not cut back during the growing season. If the red raspberry canes make a growth in excess of 5 feet, it is sometimes advantageous to tip them back to about that height in the spring prior to the starting of growth.

Gooseberry and Currant Bushes

Canes two and three years of age produce the most satisfactory gooseberries and currants. In general, the pruning of these fruits will be limited, during the first two years, to thinning out the bushes if more than eight or ten shoots have developed. After the planting is three or four years old, a systematic cutting out of the oldest wood each season is desirable, leaving young shoots to replace this old wood. This should be done during the dormant season.

Wounds Caused by Pruning

The manner in which pruning wounds are made determines to a large extent the readiness with which they heal. A stub of any considerable length left in cutting off a branch never heals. The wound made in cutting off a branch close to its supporting limb will ordinarily begin healing over at once, or as soon as the tree renews its growth if the pruning is done during the dormant season.

Probably the most important treatment for pruning wounds, where any is needed, is to keep the exposed surface in an aseptic condition. If the wounds on a tree that is sprayed with a fungicide several times a year are thoroughly coated with the fungicide each time the tree is sprayed, the danger of infection from decay-causing organisms is much reduced, if not eliminated. Small wounds that heal over in two or three years are not likely to need any other treatment.

There is, in fact, some question as to the advantage of applying any other than the fungicidal treatment to pruning wounds regardless of size. Some of the results of experimental work indicate that undressed pruning wounds have healed more rapidly than those that have been treated. However, large wound surfaces should be treated to prevent decay.

Many substances have been tried and variously recommended, but none is fully satisfactory. Among these substances are white lead paint, shellac, water glass, grafting wax (either liquid or solid), a coal-tar creosote mixture, and others, including many proprietary preparations. Practically any covering employed will need to be renewed from time to time in order to be effective.

If white lead paint or coal-tar creosote mixture are used, they should not be applied to the outer rim of the wound where they will cover the cambium, which is located just underneath the bark. Healing will be retarded if that is done. Shellac may cause little or no injury, but rather frequent application seems necessary if the surfaces are to be kept well covered. Water glass at full strength or diluted, 75 per cent of water glass and 25 per cent of water by volume, gave promising results in experimental work carried out in Ohio on muscadine grapes and silver maple trees. These treatments appeared quite effective in preventing bleeding.

The bleeding of a pruning wound, that is the flow of sap from it, which sometimes occurs, especially if the wound is made late in the spring, need cause no worry. It is comparable physiologically to the flow of sap when a sugar maple is tapped in sap time. ◆

PRUNING EUROPEAN GRAPES

Reid M. Brooks

EUROPEAN grapes, the grapes grown mostly in California, are often grown and pruned in a manner sufficiently different from that employed in the culture of other kinds (see page 49 and 51) as to warrant a separate discussion.

The first year after planting, the vine is allowed to grow undisturbed. At the first dormant pruning, all but one strong cane are removed; then this is cut back to 2 or 3 buds. Thereafter, the vines are trained and pruned to various systems according to the fruiting habits of the different varieties.

Head and Cane Pruning

Head pruning is used for varieties that fruit well on short spurs, among which are 'Muscat of Alexandria,' 'Muscat Hamburg,' and most wine grapes. A head-pruned vine has a trunk 1 to 3 feet high bearing a ring of short branches or spurs. During the second growing season, after the 2 or 3 buds have made a few inches of growth, the strongest is trained along a stake, and tied loosely; the others are removed. Laterals on these canes that outgrow the head are cut back to slow their growth. The upright cane is headed by cutting off the tip when it is a foot above the height chosen for heading.

During the third season all suckers and buds on the lower half of the trunk should be removed, those on the upper half being allowed to grow unchecked.

At the third winter pruning 3 to 5 canes are selected and cut back to spurs of 2 to 4 buds each according to the size of the canes. These will be the fruiting spurs, and they should be as near the top of the vines as is practicable.

In succeeding years the number of fruiting spurs is increased until old large-headed vines have 10 to 20 spurs and resemble the vine on page 51.

Cane pruning is used for varieties such as the 'Thompson Seedless' that have mostly unfruitful buds near the base of the canes, or for varieties with very small clusters such as 'Cabernet Sauvignon,' the 'Rieslings' and the 'Pinots.'

With cane pruning a trunk is developed similar to the trunk in head pruning. The head of the vine differs in being fan-shaped in the plane of the trellis. Cane-pruned vines are trained to a simple two-wire trellis consisting of a 6-foot stake at each vine with wires 3 and 4 feet from the ground.

At each annual pruning after the vines are in full bearing, canes with 8 to 15 buds (2 to 5 feet) are retained for fruiting. All other canes are removed except some renewal spurs of 2 buds each left near the base of each fruiting cane to produce canes for the following year.

Cane-pruned vines tend to overbear, so some of the clusters should be removed after fruiting.

Cordon Training

Cordon training, a third method, is used for table grape varieties such as 'Cardinal,' 'Emperor,' 'Malaga,' 'Red Malaga,' 'Ribier' and 'Tokay.'

A two-wire trellis with the wires 3 and 4 feet above the ground is used for support. During the second summer the vines are allowed to grow unheaded, but the main shoot and a strong lateral are chosen about 10 inches below the trellis wire to which the cordon is to be trained. All other laterals are pinched back. These selected canes are brought up to the trellis wire from the trunk in a smooth curve of 6- to 8-inch radius and tied in opposite directions along the wire to form the cordon. As they continue to grow they should be tied loosely to the wire.

Dormant pruning at the end of the second season should have the lateral arms cut back to a point where they are one half inch in diameter.

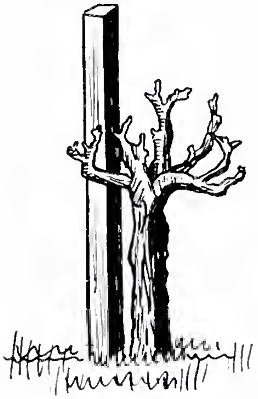
During the third season all suckers and buds developing on the lower side of the cordon should be rubbed off as they appear. New growth on the trunk and arm bends should be removed.

Shoot growth from the upper side of the arms should be tied to the upper wire so that the weight of the new canes and the foliage will not turn the cordon arms over. If the vine appears to be bearing more fruit than the vigor of the vine indicates that it should, many of the bunches should be removed as soon as possible.

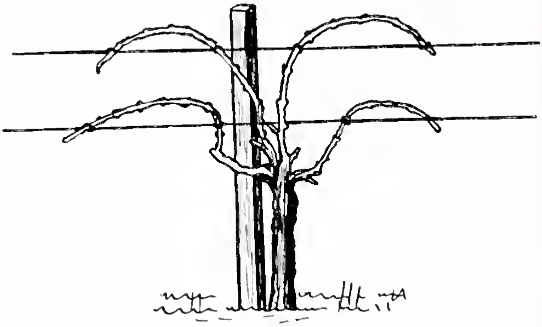
The cordon-trained vines in full bearing are pruned to leave fruiting spurs spaced 8 to 12 inches apart along the cordon arms. The spurs are cut back to 2 or 3 buds depending on cane vigor.

During the growing season strong canes from the fruiting arms should be tied to the upper wire. Growth on the trunk should be removed as it appears. Overbearing should be prevented by cluster thinning. ◆

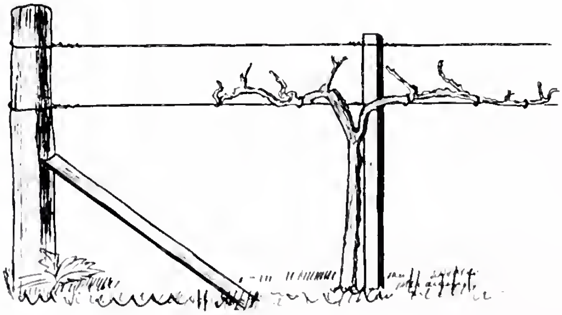
PRUNING EUROPEAN GRAPE VINES



Typical mature, head-pruned grape vine, headed at about 24 inches.



Mature cane-pruned grape vine on simple two-wire trellis.



Mature horizontal, bi-lateral cordon-pruned grape vine.

HOMEOWNER'S GUIDE TO FRUIT VARIETIES

John Einset

MANY thousands of fruit varieties exist and new ones are constantly being introduced. The proper choice of which ones to plant may be of utmost importance to the home gardener.

Commercially grown sorts are generally to be recommended. Many home plantings are found in less than ideal sites and may sometimes receive less than ideal care. Commercial varieties are apt to have inherent vigor and resistance to diseases, insects and climatic extremes, and are more likely to prosper under such adverse conditions than other types.

True, the choicest varieties as far as flavor is concerned are not always commercial ones. Many fruits can be suitable for home gardens but unsuitable for commercial farming because they lack "shelf life," the necessary "eye appeal" or possess such faults as poor production and pest resistance. Generally mail-order nurseries list the well known, established sorts and only a few novelties. Specialty nurseries may also list older and choicer varieties. The New York State Fruit Testing Association, Geneva, New York 14456, distributes an annual catalog called *New and Noteworthy Fruits.*

The following varieties are suggested for the home garden in the northeastern United States.

Small Fruits

Strawberries. See pages 16 and 66, for culture, pests and other named selections. The varieties listed here are in order of ripening.

'Gala,' very early ripening and of good quality. Avoid frosty sites because of early flowering.

'Earlidawn,' productive, soft, sour and very early. Very susceptible to verticillium wilt.

'Sunrise,' early to ripen, and with soft, light-colored berries. They do not freeze well. Resistant to verticillium wilt and the red stele fungus.

'Surecrop,' less productive than some, but with fine fruit characteristics. Resistant to red stele.

'Catskill,' the most productive of all. A midseason berry that is bright red, attractive, large and soft. Good quality. Very resistant to verticillium wilt.

'Midway,' popular commercial sort, productive, firm, red-stele resistant.

'Fairfax,' large, dark red berry with very rich flavor. An old favorite for home use.

'Fletcher,' a productive variety with large, attractive berries that are outstanding fresh or frozen.

'Sparkle,' midseason to late, excellent in quality and very popular for freezing. Berries only medium-sized. Resistant to red stele.

'Garnet,' very productive, large, firm and of good quality.

Everbearing strawberries. 'Geneva' is the best everbearer at the Experiment Station in Geneva, New York. The handsome large fruit is soft and of the finest flavor. The early crop ripens in midseason and harvests continue throughout summer and early autumn.

Red raspberries. Purchase only virus-free plants.

'Newburgh' ripens first and is productive. A large firm berry.

'Hilton,' a recent introduction, is the largest of all red raspberries. Very attractive and of excellent quality.

'Latham,' one of the hardiest, most vigorous and most reliable croppers. Fair quality.

'Taylor,' a handsome berry, is excellent for home garden and market. Fine quality.

'Amber,' named for its color, is recom-

Paris Trail for N. Y. S. Agric. Exp. Station

Apricot 'Alfred' is more likely to be hardy in regions climatically similar to New York State than most commercial varieties developed for milder areas.

mended to the home gardener for its excellent dessert quality.

"Everbearing" raspberries. 'Heritage' is the best of the fall-bearing red raspberry sorts. The summer crop is moderate. The fall crop begins to ripen about September 1 in Geneva, N.Y. and continues until frost.

Black raspberries. 'Bristol' and 'Dundee' are old varieties that are still grown. Both are productive and of good quality. Newer varieties include 'Allen,' 'Huron' and 'Alleghany.'

Purple raspberry. This berry, a cross between black and red raspberries, is highly flavored and prized for jam. 'Clyde,' a new variety for market and home use, is replacing 'Sodus' and 'Marion.'

Blackberries. 'Darrow,' because of its reliably heavy production and good fruit quality, is replacing 'Bailey' and 'Hedrick.'

Currants. 'Red Lake,' 'Stephens No. 9' and 'Wilder' are all productive red currants. 'White Imperial' is the best white-fruited one.

Gooseberries. 'Poorman' is a high quality, abundantly fruiting red variety. 'Downing' is a good one with green fruits.

Blueberries. See pages 19-21.

Elderberries. Commercial varieties are superior to the wild elderberry. 'York' is the most productive and has the largest fruits. 'Adams,' 'Johns' and 'Scotia' are other improved sorts.

Grapes. The standard commercial grapes of the Northeast are descended from some of the wild American vines of the area, but also often with a degree of European ancestry. The American type, as exemplified by 'Concord,' has typically a slipskin character and pronounced fruity flavor. The European type is sweet, more neutral in flavor, and has a crisp flesh that does not separate from the skin. Some of the newer American-type introductions have a high proportion of "European blood" in their background and more closely resemble grapes of European origin. In order of ripening, good varieties are:

'Ontario,' a very early white; distinctly American.

'Seneca,' an early white, is a nearly pure European type of the highest dessert quality.

'New York Muscat,' sweet and pleasing, is a rich blend of American fruitiness and European muscat flavor.

'Buffalo,' a midseason blue, is one of the very finest for eating. Also excellent for juice and jelly.

'Delaware,' the standard red, has fine quality. It is a beautiful vine but sometimes lacks vigor.

'Niagara,' the standard midseason white, is vigorous and productive. Good for a very fruity juice or for wine.

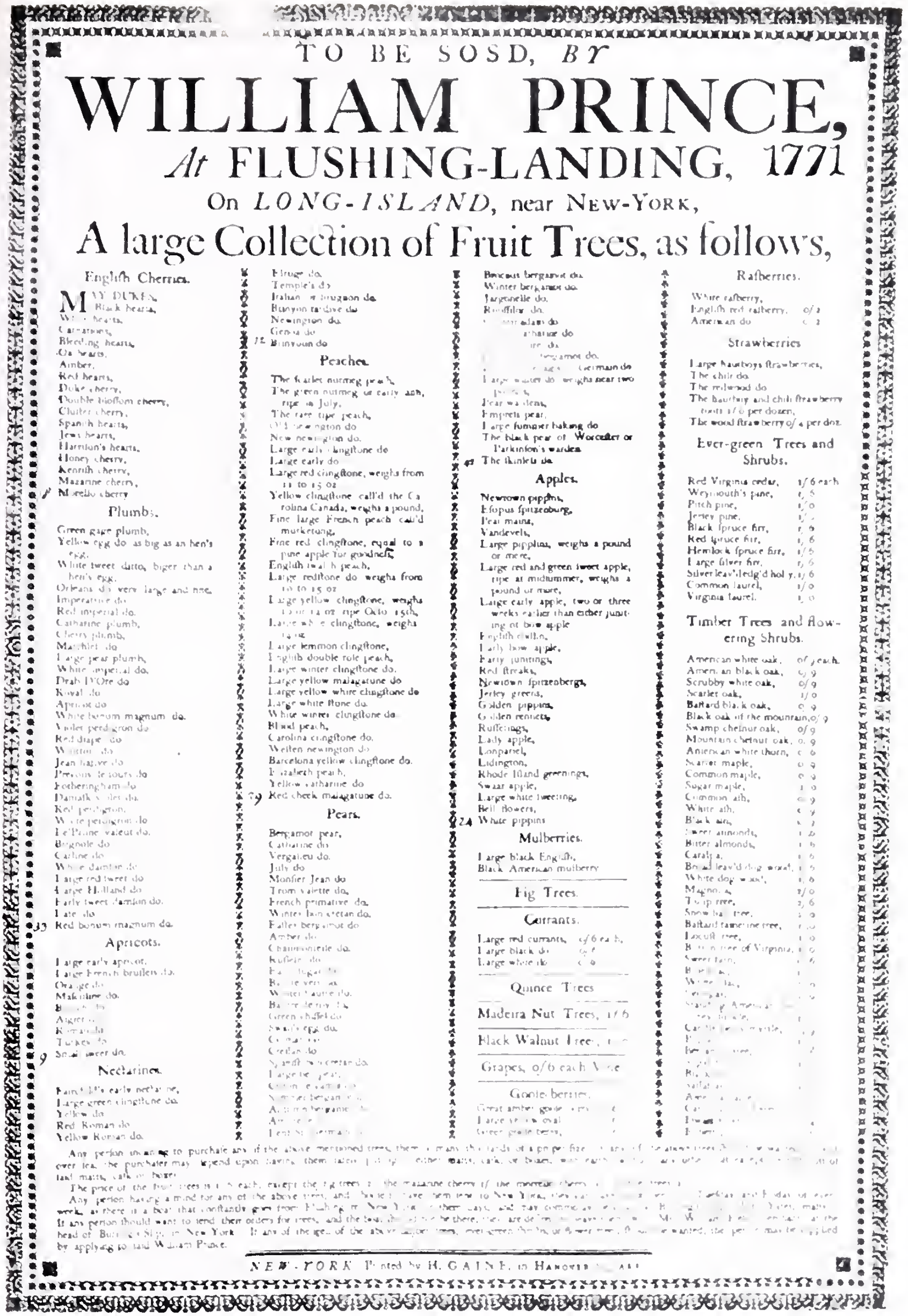
'Steuben,' the finest of recent introductions, is vigorous and bears abundantly. It has a delicious, spicy flavor.

'Urbana' and 'Yates' are late red varieties. Both are outstanding keepers, good for three months in the refrigerator.

Seedless grapes. 'Concord Seedless' has the flavor and aroma of 'Concord.' Very fine for grape preserves and pie.

More recent white seedless introductions are worthy of trial where minimum temperatures rarely go below —10°F. 'Interlaken Seedless' is very early. 'Himrod' has excellent quality.

Wine grapes. Interest in special varie-



TO BE SOLD, BY

WILLIAM PRINCE,

At FLUSHING-LANDING, 1771

On *LONG-ISLAND*, near NEW-YORK,

A large Collection of Fruit Trees, as follows,

Engliſh Cherries.

MAY DUKES,
Black hearts,
White hearts,
Carnations,
Bleeding hearts,
Ox hearts,
Amber,
Red hearts,
Duke cherry,
Double bloſſom cherry,
Cluſter cherry,
Spaniſh hearts,
Jews hearts,
Harriſon's hearts,
Honey cherry,
Kentiſh cherry,
Mazanne cherry,
Morello cherry 17

Plumbs.

Green gage plumb,
Yellow egg do. as big as an hen's egg.
White ſweet ditto, bigger than a hen's egg.
Orleans do. very large and fine,
Imperatrice do.
Red imperial do.
Catharine plumb,
Cherry plumb,
Matchlet do.
Large pear plumb,
White imperial do.
Drab D'Ore do.
Royal do.
Apricot do.
White bonum magnum do.
Violet perdigron do.
Red diaper do.
Winter do.
Jean hative do.
Precoce de tours do.
Fotheringham do.
Damaſk violet do.
Red perdigron,
White perdigron do.
Le'Prune valeur do.
Brignole do.
Carline do.
White damſon do.
Large red ſweet do.
Large Holland do.
Early ſweet damſon do.
Late do.
33 Red bonum magnum do.

Apricots.

Large early apricot,
Large French bruſlers do.
Orange do.
Makirline do.
[illegible]
Angers do.
Romand do.
Turkey do.
9 Small ſweet do.

Nectarines.

Fairchild's early nectarine,
Large green clingſtone do.
Yellow do.
Red Roman do.
Yellow Roman do.
Elruge do.
Temple's do.
Italian or brugnon do.
Brunyon tardive do.
Newington do.
Genoa do.
12 Brunyoun do.

Peaches.

The ſcarlet nutmeg peach,
The green nutmeg or early Ann, ripe in July,
The rare ripe peach,
Old newington do.
New newington do.
Large early clingſtone do.
Large early do.
Large red clingſtone, weighs from 11 to 15 oz.
Yellow clingſtone call'd the Carolina Canada, weighs a pound,
Fine large French peach call'd murketong,
Fine red clingſtone, equal to a pine apple for goodneſs,
Engliſh ſwalch peach,
Large redſtone do. weighs from 10 to 15 oz.
Large yellow clingſtone, weighs 13 or 14 oz. ripe Octo. 15th,
Large white clingſtone, weighs 14 oz.
Large lemmon clingſtone,
Engliſh double roſe peach,
Large winter clingſtone do.
Large yellow malagatune do.
Large yellow white clingſtone do.
Large white ſtone do.
White winter clingſtone do.
Blood peach,
Carolina clingſtone do.
Weſten newington do.
Barcelona yellow clingſtone do.
Elizabeth peach,
Yellow catharine do.
79 Red cheek malagatune do.

Pears.

Bergamot pear,
Catharine do.
Vergaleu do.
July do.
Monſier Jean do.
Trom valette do.
French primative do.
Winter bon cretan do.
Fallet bergamot do.
Amber do.
Chaumontelle do.
Ruſlete do.
[illegible]
[illegible]
Winter [illegible] do.
[illegible]
Green chiſſel do.
Swan's egg do.
[illegible]
Cretian do.
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Brocas bergamot do.
Winter bergamot do.
Jargonelle do.
Rouſſilor do.
[illegible] adams do.
[illegible] catharine do.
[illegible]
[illegible] bergamot do.
[illegible] Germain do.
Large winter do. weighs near two pounds,
Pear wardens,
Empreſs pear,
Large ſummer baking do.
The black pear of Worceſter or Parkinſon's warden
47 The ſkinleſs do.

Apples.

Newtown pippins,
Eſopus ſpitzenburg,
Pear mains,
Vandevels,
Large pipplins, weighs a pound or more,
Large red and green ſweet apple, ripe at midſummer, weighs a pound or more,
Large early apple, two or three weeks earlier than either juniting or bow apple
Engliſh codlin,
Early bow apple,
Early junitings,
Red ſtreaks,
Newtown ſpitzenbergs,
Jerſey greens,
Golden pippins,
Golden rennets,
Ruſſetings,
Lady apple,
Nonpariel,
Lidington,
Rhode Iſland greenings,
Swaar apple,
Large white ſweeting,
Bell flowers,
24 White pippins

Mulberries.

Large black Engliſh,
Black American mulberry

Fig Trees.

Currants.

Large red currants, 0/6 each,
Large black do. 0/6
Large white do. 0/6

Quince Trees

Madeira Nut Trees, 1/6

Black Walnut Trees, [illegible]

Grapes, 0/6 each Vine

Gooſeberries.

Great amber gooſeberry, [illegible]
Large yellow oval [illegible]
Green gooſeberry, [illegible]

Raſberries.

White raſberry,
Engliſh red raſberry, 0/2
American do. 0/2

Strawberries

Large hautboys ſtrawberries,
The chili do.
The redwood do.
The hautboy and chili ſtrawberry roots 1/6 per dozen,
The wood ſtrawberry 0/4 per doz.

Ever-green Trees and Shrubs.

Red Virginia cedar, 1/6 each
Weymouth's pine, 1/6
Pitch pine, 1/0
Jerſey pine, [illegible]
Black ſpruce firr, 1/6
Red ſpruce firr, 1/6
Hemlock ſpruce firr, 1/6
Large ſilver firr, 1/6
Silver leav'd edg'd holly, 1/6
Common laurel, 1/0
Virginia laurel, 1/0

Timber Trees and flowering Shrubs.

American white oak, 0/9 each.
American black oak, 0/9
Scrubby white oak, 0/9
Scarlet oak, 1/0
Baſtard black oak, 0/9
Black oak of the mountain, 0/9
Swamp cheſnut oak, 0/9
Mountain cheſnut oak, 0/9
American white thorn, 0/6
Scarlet maple, 0/9
Common maple, 0/9
Sugar maple, 1/0
Common aſh, 0/9
White aſh, 0/9
Black aſh, [illegible]
Sweet almonds, 1/6
Bitter almonds, 1/6
Catalpa, 1/6
Broad leav'd dog wood, 1/6
White dog wood, 1/6
Magnolia, 2/0
Tulip tree, 2/6
Snow ball tree, 1/0
Baſtard tamerine tree, [illegible]
Locuſt tree, 1/0
[illegible] tree of Virginia, 1/0
Sweet fern, [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

Any perſon intending to purchaſe any of the above mentioned trees, [illegible] over ſea, the purchaſer may depend upon having them taken [illegible] either matts, caſk, or boxes, [illegible] ſaid matts, caſk or boxes.

The price of the fruit trees is [illegible] each, except the fig trees, [illegible] the mazanne cherry [illegible] the moreeld cherry [illegible]

Any perſon having a mind for any of the above trees, and [illegible] have them ſent to New York, they can [illegible] Tueſday and Friday of every week, as there is a boat that conſtantly goes from Fluſhing to New York on them days, and may come [illegible] Yates, matts. If any perſon ſhould want to ſend their orders for trees, and the boat [illegible] be there, they are deſired to [illegible] Mr. [illegible] at the head of Burling's Slip, in New York. If any of the [illegible] of the above [illegible] trees, ever-green ſhrubs, or flower [illegible] wanted, the [illegible] may be ſupplied by applying to ſaid William Prince.

NEW-YORK: Printed by H. GAINE, in Hanover [illegible]

An announcement of nursery stock, including a large offering of fruit-bearing trees and shrubs, available from William Prince in 1771. The plants were shipped by boat from Flushing to Burling's Slip, New York City, every Tuesday and Friday.

ties for home winemaking appears to be growing rapidly. Most of the varieties already listed produce fine, fruity wines. On the Continent, breeders have been working with the vine, too, and the French hybrids, another group of grapes with both American species and the European *Vitis vinifera* in their ancestry are suitable for more neutral, dry table wines. Two readily available sorts for white wine are 'Aurora' (Seibel 5279) and 'Seyval' (Seyve Villard 5-276). Red wine grapes commonly grown are 'Foch,' 'Baco Noir' and 'Seibel 9549.'

Tree Fruits

Apples. See page 9 concerning rootstocks that will keep apple trees dwarf. They are strongly recommended for the home grower.

The following varieties, available on various kinds of rootstock, provide fruit from August through October.

Summer Varieties

'Julyred,' one of the best very early red apples. Good eating quality.

'Viking,' another new early dark red. Fine for desserts.

Fall Varieties

'Tydeman Early' ripens in early September. The fruit is handsome—a beautiful red, and the quality is fair. The tree has a straggly growth habit.

'Milton' ripens a week later. The attractive apples are good for sauce or dessert.

'Macoun' has the finest eating quality of the 'McIntosh' types. Very dark red.

'Cortland' is excellent for dessert, pies and salads.

Winter Varieties

'Empire,' an outstanding 'McIntosh' type. It ripens two weeks later and is most attractive. The tree has a very desirable habit of growth.

'Jonagold,' a handsome golden fruit with a scarlet stripe. It has very fine dessert quality and is also good for processing.

'Spigold,' a large 'Northern Spy' type of apple with exceptionally high quality.

'Golden Delicious,' one of the best known varieties, tends to bear fruit too heavily, and the apple skin is very subject to russet.

'Idared' is a late red. Quality develops after storage. Trees are small and productive.

'Melrose,' a late 'Jonathan' type. Excellent for eating fresh or storing.

'Mutsu,' similar to a later 'Golden Delicious,' has large fruits that are not subject to russet. They also store well.

Disease-Resistant Apples. Varieties resistant to apple scab fungus and other diseases have been developed through the cooperative efforts of several state experiment stations. Some of them may be found valuable for the home grower. To date, only one has been named, 'Prima,' an early dessert-type apple.

Pears. Two or more varieties should be planted to insure cross pollination. Most pears are harvested when still firm and ripened at 65°F. or cooler for best eating.

'Clapps Favorite,' the earliest commercial sort, has large, good quality fruit. Short season.

'Worden Seckel,' a good small russet pear. Fruit ripens on tree.

'Aurora,' a beautiful dessert pear ripening before 'Bartlett.'

'Bartlett,' the most important commercial pear for fresh and processing use. Large fruit with distinctive flavor.

'Gorham' is a late 'Bartlett' type with excellent flavor.

'Seckel,' a midseason variety with small fruit. Very fine either fresh, spiced or pickled. Ripens on the tree.

'Bosc,' a large, late-ripening pear that keeps well. Excellent.

'Dumont,' a late, attractive, high quality variety for the home orchard.

Peaches. The following are excellent yellow-fleshed varieties that ripen over a six-week period at rather regular intervals, from early through midseason: 'Collins,' 'Sunhaven,' 'Jerseyland,' 'Redhaven,' 'Triogem,' 'Halehaven,' 'Madison' and 'Redskin.'

'Elberta' is late and may not reach

Paris Trail for N. Y. S. Agric. Exp. Station

The white grape variety 'Interlaken Seedless' is recommended for regions where minimum temperatures rarely fall below —10 degrees F. It is an early variety.

maximum maturity in cool summers. 'Erly-Red-Fre,' 'Raritan Rose' and 'Red Rose' are good white-fleshed varieties. 'Prarie Dawn' and 'Veteran' are among the most cold-hardy varieties.

Apricots. Varieties grown commercially in other parts of the country have not been regularly productive in New York. Recent introductions from the Michigan, Vineland (Ontario) and New York Experiment Stations are more likely to succeed. Among them: 'Alfred,' 'Veecot' and 'Goldcot.'

Cherries. At least two varieties of sweet cherries must be planted for cross pollination. Among the best are:

'Emperor Francis,' the finest white or light red cherry. Large, midseason, excellent.

'Ulster,' a midseason variety, has very dark, firm, crisp fruit that is juicy and fine.

'Merton Bigarreau,' a black cherry from England, is handsome and very productive. Will not pollinate 'Windsor.'

'Windsor,' one of the best known, has late, dark red fruit. Productive, reliable.

The sour or tart cherry is especially prized for pie. 'Montmorency,' the standard variety, has colorless juice. 'Northstar' and 'Meteor' are very hardy and tart. The former has colored juice.

The Duke cherries are intermediate forms between sour and sweet. Varieties: 'May Duke' and 'Royal Duke.'

Plums. Of the prune-type plums 'Stanley' does best in the Northeast. It is replacing 'Italian Prune' ('Fellenberg'), long the standard commercial variety.

The Gage plums are of highest dessert quality and good for jam. 'Reine Claude,' a clingstone and 'Green Gage,' a freestone, are outstanding representatives.

Damsons are small blue, tart plums prized for jams and preserves. 'Shropshire' and 'French Damson' are good varieties.

Japanese plums have perfumed flesh and are commonly eaten fresh. They are not suitable for culinary purposes. 'Shiro' is an attractive early yellow one with fair quality. Others are 'Burbank,' which is productive, and 'Santa Rosa,' a standard shipping variety. ◆

PROGRESS IN PEST CONTROL

Edward H. Smith

THE PAST THREE DECADES have witnessed remarkable progress in pest control. Prior to this time, little encouragement could be offered to the home gardener who wished to grow fruits. Pesticides then available were of limited effectiveness and some, such as lead arsenate, often caused injury to trees.

A new era began in 1942 with the introduction of DDT. Since then, literally hundreds of new pesticides have appeared from organic chemists here and abroad. Although these potent chemicals have revolutionized pest control, they are not the final answer. Their use sometimes upsets the balance of nature, resulting in exchanging one pest for another. And too, chemical control provides no permanent solution to the pest problem. The professional in pest control is well aware of these limitations but, until research opens new avenues, he is forced to continue with methods which, despite their drawbacks, currently provide the means for producing higher yields with less loss from pests than ever before.

In recent years there have been two important trends which bear on pest control in the home garden. First is the growing concern for the effect of pesticides on the environment. Emphasis had heretofore been directed chiefly to the individual exposed to pesticides in applying them and to the consumer of treated fruits. The current broader environmental concern is fully justified and reasonable individuals can adopt measures which reconcile practical pest control and appropriate ecological considerations.

The second trend is the growing appreciation of the esthetic value of activities which reduce the stress of modern living and enhance the quality of living. Home fruits provide such benefits.

Selective Killing Needed

The problem in pest control is to kill pests without harming other organisms living in close association with them. To achieve this selective killing is a large order, because the vital processes of pests, plants and mammals, including man, all have some features in common. Before considering the decimation of the pests, thought must be given to safeguarding other living organisms in the biological complex of the home orchard. They include the trees on which the fruit is produced, the orchardist who tends them, the consumer and finally the environment.

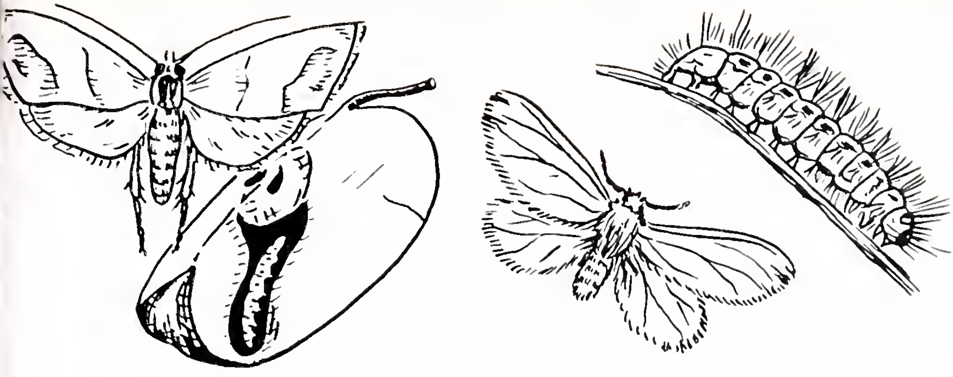
Protection for the Trees

Spraying trees with chemicals is at best an unnatural practice which is likely to interfere with the normal processes of the plant. Such interference with the tree should be kept to a minimum: To do this, a few principles should be kept in mind.

Don't overspray. The philosophy that "if a little is good, a lot is better" is unsound. Spray till leaves and fruit are wet. Don't worry if only a light residue is visible after the spray dries. If the spray dries before a summer shower, chances are that little effectiveness is lost. If a washing rain occurs (½ inch or more), better spray again a few days later. Spray injury is most likely under drying conditions. Extremes of temperature increase the likelihood of spray injury. Low temperatures at the time of spraying may cause fruit russet, while high temperatures cause scald. Keep the number of pesticides in the spray mixture to a minimum. By using materials with a wide range of effectiveness, all-round protection can be had with fewer materials.

Protection for the Grower

While pesticides available to the home orchardists are reasonably safe, their misuse can render them unsafe. Your



Handbook of the Insect World, Hercules, Inc. and 4-H Clubs

Left: Codling moth, which has a ¾-inch wing span, is the most important pest of apple. The larvae feed on apple fruits through most of their development. *Right:* The fall webworm has a wing span of 1 ¼ inches. Its caterpillars feed on the foliage of apple and other fruit trees, forming nests at the ends of branches.

best protection is the label. It provides answers to three essential questions:

1. What is the chemical?
2. Against what pests is it effective?
3. How can it be safely used?

The manufacturer has been required by law to meet exacting requirements before making claims on the label for his product. While there is no law to require the user to read the label, common sense dictates it. The two chief safeguards in the use of pesticides are:

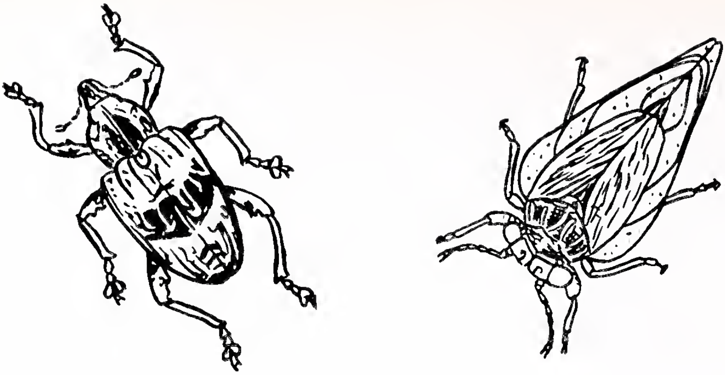
1. Follow directions on the label.
2. Store pesticides in a safe place—out of reach of children and pets.

Protection for the Consumer

Much publicity has recently been given to the hazard of chemicals in food. The chemical age is relatively new and new practices have traditionally come under criticism before gaining public acceptance. Federal agencies are charged with the responsibility of safeguarding public health. To do this, residue tolerances applicable to produce offered for sale are established, based on extensive tests with laboratory animals. It is difficult for the layman to determine the adequacy of these safeguards, but we believe that he will find the program in responsible hands.

Several natural factors operate to reduce spray residue which is present at harvest: 1. The chemical is greatly diluted with water before spraying. 2. Limited quantities of the chemicals can be made to adhere to the fruit and foliage in a single spray. 3. The action of sunlight, rain and wind immediately begins to break down the chemicals.

We often hear laments about the countless pests which now attack our crops. Several factors, real and imaginary, account for the impression that the situation is worse than formerly. First is the human tendency to imagine the "good ole days" as better than they were. With lower standards, produce then acceptable to the market or to the home orchardist could not meet current standards. Second, it is true that we now have more pests to contend with. There are the native pests to which we fell heir when the early settlers introduced cultivated fruits to this country. In addition, we have the introduced pests which inevitably gained access through international commerce. To add to our troubles, some minor pests have become major pests through shifts in the balance of nature. Another factor which can contribute to the problem of the home orchardist is the presence of adjoining



Handbook of the Insect World, Hercules, Inc.

Left: The plum curculio, which is about ¼ of an inch long, is common pest of the stone fruits. *Right:* The pear psylla is 1/10 of an inch in length. It sucks sap from foliage, discoloring and stunting the fruit and lowering tree vitality.

unsprayed plantings which provide sanctuaries for pests. Despite all of this, pest-free fruit can and is being produced with reasonable effort.

To the uninformed, an air of mystery surrounds the activity of insects and other pests. This is probably a carryover from the early days when pests were regarded with supersitition and ignorance. The development of pests proceeds with the same regularity and in response to some of the same life forces as does that of the host plants which are more readily observed. For instance, the spring activity of both the apple tree and the plum curculio is regulated by temperature. Host and pest are so synchronized that year in and year out the curculio usually emerges from hibernation and arrives in the tree as it comes into bloom. With a little study, the home orchardist can also develop practical know-how in pest control. Vigilance in detecting pests can become a fascinating feature of home gardening.

Protection for the Environment

Pesticide usage has increased enormously over the past three decades and while safeguards for the trees, the grower, and the consumer have generally been adequate, the environment has not been well protected. This is not due to willful neglect, but to a lack of realization, until just recently, of the long term subtle effects of escaped pesticides, particularly the persistent ones, upon the environment.

A few states have enacted protective legislation to meet specific problems in their areas. Most of the rest are considering such laws. The federal government under the new Environmental Protection Agency is considering new legislation and is currently reviewing the uses of pesticides. It has prohibited or restricted certain uses of several pesticides because of potential hazard to the environment. Some states have taken even more restrictive action, so that federally labeled uses may not be allowed within such states.

The trend of present and future legislation is to categorize pesticides in groups. "Unrestricted" are those safe enough to be used by the general public. "Restricted" are those that are either highly toxic or are environmentally hazardous to some degree and available only by permit. Certain pesticides may be so environmentally hazardous that all uses are prohibited. The trend is also toward training and licensing of custom applicators and toward "prescription use" of hazardous materials. Changes in regulations will likely occur over the next several years. You should check with local sources of information such as your Cooperative Extension Service for timely information.

Effective Pesticides

A general purpose spray, meeting the needs of the home orchardist, has long been sought. No single pesticide effective against all of the pests has been found and many of the more effective pesticides employed commercially are considered too dangerous for use about the home garden.

In recent years, a number of low hazard yet effective materials were developed. Efforts to combine them so as to provide all-round effectiveness would seem a simple matter, but it involved complex problems of compatibility: the chemicals in combination often either lost their effectiveness when stored, or produced injury when applied to the foliage. Once this problem was overcome, the one-package general-purpose mixture became a reality.

While general-purpose mixtures are more convenient to use, the ingredients may be purchased separately and mixed in water as needed. The most effective pesticides, which have the human and environmental safety features needed, are listed in the accompanying table together with recommended dosage.

Malathion, methoxychlor and carbaryl (Sevin) are effective against insects, while captan is included for control of plant diseases. Mixtures of this general type are being marketed under various trade names. Those having essentially this composition should prove satisfactory. Their identity can be verified by checking the label on the package.

Timing of Treatments

The development of pests is closely correlated with the development of the tree, both being regulated by temperature. For this reason, sprays are generally timed according to the tree's development which can be more readily observed than the pests themselves. Seasonal variations tend to equalize several weeks after bloom so timing is not then so critical. Sprays applied after the fruit is formed are termed "cover sprays," and are generally applied at intervals of approximately ten days.

The most important period of pest activity is during the several weeks fol-

Pesticides for Use in the Home Orchard

	Quantities to make	
Insecticides	*1 gallon*	*25 gallons*
Malathion (25% wettable powder)	2 tbsp.	½ lb.
Methoxychlor (50% wettable powder)	3 tbsp.	⅗ lb.
Sevin* (carbaryl) (50% wettable powder)	2 tbsp.	½ lb.
Fungicide		
Captan (50% wettable powder)	3 tbsp.	¾ lb.

The pesticides listed above are included in most multiple purpose mixtures offered for sale. Sevin may be substituted for malathion or methoxychlor in late season sprays.

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* Sevin should not be used on apples within three weeks of petal fall because it causes fruit thinning when applied early.

Timing Schedule of Sprays for Control of Fruit Pests

Stage of tree development	*Apple*	*Peach*	*Plum*	*Cherry*	*Pear*
Dormant		*			
Green-tip	X	(note below)			
Pre-bloom	X	X	X	X	X
Bloom		Do not spray during bloom			
Petal fall	X	X	X	X	X
1st cover	X	X	X	X	X
2nd cover	X	X	X	X	X
3rd cover	X			X	
4th cover	X	X		X	
5th cover	X				
6th cover	X	X			X
7th cover	X				X

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* Spray with ferbam, 2 tablespoons per gallon, or ½ lb. per 25 gallons.

Definition of terms:

Dormant—Before buds show any green.
Green-tip—When buds have broken enough to show green tissue.
Pre-bloom—When blossom buds begin to show color.
Bloom—When blossoms are open.
Petal fall—When the last petals have fallen from the blossoms.
1st cover—10 days after petal fall.
2nd-through-7th cover—At 10- to 14-day intervals.

Add Kelthane if mites become a problem.

lowing bloom. (Caution: Sprays must not be applied during bloom because of the risk of killing bees.) The effect of a single spray lasts for approximately ten days. Usually several species of pests are susceptible to treatment at the same time so a single spray may provide protection against a number of pests. Sprays should not be applied later than one or two weeks before harvest. The safe interval for a particular formulation will appear on the label.

Thorough Coverage Essential

As would be expected, effective control can be obtained only when the fruit and foliage are thoroughly covered. This poses a difficult problem to the home gardener, especially one with large or poorly pruned trees. Manufacturers of commercial spray machinery now offer small-capacity power sprayers suitable for the home orchard. The chief drawback to such equipment is its high cost, considering returns on the investment.

The problem of coverage is greatly simplified by the use of dwarf trees which remain within reach of a knapsack sprayer.

Diseases and Pests of Specific Fruits

Each of the fruits grown in the home orchard presents a different problem with respect to pest control. This fact should be considered in selecting the fruits best suited to home plantings.

Apple. The apple has perhaps the largest number of pests of all fruits. The codling moth and apple scab are the major problems. Scab accounts for loss of foliage and disfigured fruit.

Infection occurs during periods of rainfall from the time green tissue appears in the spring until late June. The home gardener is advised to select varieties least susceptible to scab disease. The codling moth (p. 61) is the chief cause of wormy apples. Other common pests of the apple include plum curculio, aphids, apple maggot, bud moth, and leaf rollers.

Pear. The chief pest of pears is the pear psylla which covers the fruit and foliage with sticky honeydew, reduces the vigor of the tree, and stunts the fruit. The codling moth attacks pears as well as apples but to a lesser extent. Because of its relatively few pests, the pear is well suited to home plantings.

Stone fruits—peaches, plums, cherries. All of the stone fruits have some of the same pests, notably plum curculio and brown rot. The curculio may be distinguished by its crescent-shaped egg-laying scar. The fruits of peaches and plums infested by the plum curculio drop from the tree before maturing, while infested cherries remain on the tree and may be harvested.

In addition, peaches are attacked by the Oriental fruit moth which kills the tender terminal shoots and later produces wormy peaches. Peach trees must also be protected from borers by spraying the trunk and branches. Two species of borers attack the trees. The larger one confines its attack to the tree trunk at soil level, while the smaller one attacks scaffold branches as well as the trunk. The peach tree borer (at soil level) is a particularly troublesome pest, often killing trees outright. The borers are among the easiest pests to control, yet, because they are frequently overlooked, account for perhaps the most serious injury. One disease of peach, leaf curl, does not respond to captan and requires a special dormant treatment with ferbam as noted in the table.

Plums and prunes have relatively few pests besides curculio and brown rot. In severe infestations, the entire crop may drop before harvest, due to injury by the plum curculio. Fruits drop from the tree from other causes such as poor tree vigor, poor pollination, and excessive crop. The presence of worms in the drooped fruits is sure evidence that the curculio is responsible.

Wormy cherries are produced by cherry fruit fly as well as plum curculio. The foliage is attacked by the cherry leaf spot disease which causes leaves to turn yellow and drop prematurely. Sour cherries are more severely attacked by both fruit flies and leaf spot than are sweet cherries.

In some cases, mites have become a problem even where the recommended combination of pesticides is used, probably due to the development of resistance. When mites are a problem, Kelthane should be used following manufacturer's directions. The presence of mites can be detected by carefully inspecting the undersides of the leaves with a magnifying glass. Severe injury, which reduces the vigor of the trees, is apparent from the bronzed foliage color.

The timing of sprays required for control of pests on various fruits is given in the table. This program eliminates dormant sprays with the exception of one treatment for peach leaf curl. Dormant sprays for the home orchardists have been better in theory than in practice. While the idea of striking the immobile pests before they become active is sound, several considerations such as unfavorable weather, hinder its accomplishment.

It can be said that the outlook for pest control in the home orchard is greatly improved. Effective pesticides are available. Small power sprayers have been designed to meet home growers' needs. Dwarf trees are available which simplify spraying and harvesting. These developments go a long way in making it practical to carry out the three essentials of pest control. If control measures fail, each of these factors should be considered carefully to account for the results obtained. ◆

The author gratefully acknowledges the assistance of J. L. Brann and J. E. Dewey in the revision of this material.

CONTROLLING SMALL FRUIT PESTS

George L. Slate and Ellsworth Wheeler

SMALL FRUITS in general are troubled less by diseases and insects than are tree fruits. Many home gardeners and even commercial growers often do not spray their berry plantings. Nevertheless there are occasions when spraying is necessary. It may save a crop which might be a complete loss if unsprayed; and it may often reduce losses which are unrecognized by the grower. It is always good insurance to know what troubles may occur and to watch for their appearance. If they are frequent, it will pay to spray the crop according to the spray programs available from most Agricultural Extension Services at State Colleges of Agriculture, or from county agencies.

Information on labels of pesticide containers provides an essential guide to effective and safe use of these valuable chemicals. The directions given for dilutions, dosages and methods of application should be followed closely. Warnings indicate the plants that may be damaged, preharvest intervals and any special precautions. Materials available to home gardeners may not be the most effective in all cases, but they are considered the safest. They will prove adequate when used as directed at the right time. Several brand-name mixtures are available which contain captan, a fungicide for disease control, methoxychlor and malathion for insect control, and with or without Kelthane to check mites. These mixtures are convenient for the home gardener and are referred to as general or all-purpose mixtures in the following discussion.

Strawberries have their share of insects and diseases, but most home gardeners ignore them unless they become serious. Often no trouble is encountered, or the loss is accepted as being not worth the bother of controlling each year when the insect or disease may not be present, or is causing very little injury.

Strawberry Insects

The tarnished plant bug feeds on young fruits before they expand, causing hard seedy ends to develop. Formerly such injured berries, known as nubbins, were thought to be the result of poor pollination or frost injury to the blossoms. The plant bug is easily controlled by spraying the plants with methoxychlor or the general-purpose mixture described above. Make the application just before the first flowers open. Plant bugs become more numerous as the season progresses, and thus may be very injurious to everbearing varieties of strawberries.

Cyclamen mite. This very tiny mite, feeds on the young leaves before they unfold, causing severe stunting. If the infestation is serious, the plant is worthless. Northern gardeners should discard their plantings and replace them with plants from Maryland as the insect ordinarily does not live through the summer in that latitude. It is primarily a pest of strawberries in the northern states and Canada. Kelthane applied as a very heavy crown drench will reduce cyclamen mite damage.

White grubs may infest strawberries planted after a grass sod. They feed on the roots. If grubs are seen when the soil is being prepared for planting, apply chlordane according to instructions on the package, providing the regulations of your state permit its purchase and use for this purpose.

Strawberry Diseases

Leaf troubles. Three diseases cause spotting or discoloration of the leaves. They are leaf spot, leaf scorch and leaf blight, and are rarely troublesome on present-day varieties, but often exist in strawberry beds where air circulation is poor or there has been a wet season. Spraying is not likely to be worth while unless the injury is severe every year, in which case a more resistant variety should be sought.

Red stele is a fungus disease of the roots, usually serious only in poorly drained soils or in other soils in very wet springs. The center of the root is reddish-brown and the roots decay. The varieties 'Sparkle,' 'Redglow,' 'Red Chief,' 'Guardian,' 'Sunrise,' and 'Surecrop' are resistant.

Verticillium wilt is another soil fungus, usually serious only when strawberries are grown after tomatoes. Keep strawberries out of soil that has grown tomatoes. These varieties are somewhat resistant to wilt: 'Catskill,' 'Sunrise,' 'Guardian,' and 'Cavalier.' Moderately resistant varieties are 'Surecrop,' 'Robinson' and 'Grenadier.'

Viruses cause the plants to decline in vigor and become less productive. There are no visible symptoms. Plants from nurseries practicing control measures are mostly quite virus-free and should be used in preference to plants that are several years removed from such a program.

Fruit rot may be serious in wet years, especially in beds that are too thick. If wide, dense beds are fertilized with a nitrogenous fertilizer in the spring of the bearing year and the season is wet, most of the crop will rot. Keep fertilizers off the bed in the spring of the fruiting year, keep the rows narrow (not over a foot wide) or, preferably, in hills to reduce rotting. Captan sprays may reduce rot somewhat.

Other Troubles

Sterile flowers. Many flowers may fail to develop into berries. Usually this is caused by having the plants too thick and too vigorous.

Winter injury is usually found in unmulched beds or in beds where the mulch was applied after the plants experienced severe cold. The plants wilt and die about the time the berries begin to ripen. If examined, the interior of the crown is found to be brown. Mulching the plants with at least 2 inches of straw before the temperature drops below 20°F. should give adequate protection against low winter temperatures.

Roche

When strawberry flowers fail to develop into fruits, the reason can be that the plants are too thick and too vigorous.

Slugs eat holes in the berries, especially in wet weather. Use a metaldehyde bait according to directions.

Raspberry Pests

Raspberries are often grown without much attention being paid to the control of insects and diseases, but most garden plants need some control measures if they are to thrive.

Wild raspberries and run-out garden and commercial plantings nearby may harbor virus diseases, orange rust and various insect pests of raspberries. They should be avoided or removed if possible or their troubles may spread to new plants nearby.

Raspberry fruitworm causes wormy berries and destroys blossom buds. If present, it may be controlled by spraying the plants with methoxychlor or general purpose spray. The first application is made when blossom buds first appear, the second just before the first flowers open. This spray is also helpful in controlling stink bugs and various borers.

Borers. Several kinds tunnel in canes. Infested canes should be cut out and burned. Wilted tips of new shoots are caused by insects laying eggs which later hatch to release borers. The wilted tips should be removed and destroyed.

Tree crickets lay a row of eggs in the upper portion of the cane, weakening it so that the cane breaks at that point. Remove and burn the portion of the cane containing the eggs when pruning the plants.

Virus diseases. There are several virus diseases of raspberries, varying in their symptoms and their effects on the plant. Plants of some varieties rarely become infected; others may become infected, but are so tolerant of the virus that they will continue to produce fairly good crops. Others, especially the black raspberries, may be killed by the virus. Destroy old plantings or nearby wild raspberries, since they often harbor virus diseases.

Mosaic. One should learn the symptoms of mosaic and remove infected plants as soon as discovered. If this is done promptly and there are no sources of infection nearby, the planting may be kept in good health for many years.

Some red raspberry varieties, 'September,' 'Milton' and 'Indian Summer,' usually escape mosaic and it is not necessary to pay special attention to keeping them away from mosaic-infected raspberries. All of the black and purple raspberries are seriously injured by viruses and every precaution must be taken to protect them.

Verticillium wilt. This soil-borne fungus attacks the roots of black and purple raspberries causing the canes to develop a bluish color and soon die. It is much more serious in raspberries that are planted on land that has recently grown tomatoes, peppers, eggplants and potatoes; hence, raspberries should not follow these crops except after an interval of several years. Wilt-infected plants should be removed from the planting when detected.

Spur blight causes large purplish areas surrounding the buds of red raspberry varieties and may kill them. Narrow rows, keeping the weeds down, and good air circulation will reduce losses.

Anthracnose causes spotting of the canes of black and purple raspberries. Good air circulation may reduce damage, but prolonged wet periods favor the fungus and considerable damage may result. If there are too many lesions on the canes, they may be winter-killed the following winter. Control is by spraying the canes in the spring with lime-sulfur, 4 gallons in 100 gallons of water, when the new leaves are about ½ inch in diameter.

Orange rust. This systemic disease is caused by a fungus which stunts the plants so they are worthless. Yellow pustules appear on the undersides of the leaves. Infected plants should be destroyed promptly in the planting, and wild and cultivated brambles nearby.

Other Troubles of Raspberries

Crumbly berries. These are caused by the tomato ring spot virus. Affected plants do not recover so they may as well be replaced with a new stock.

Winter injury. Raspberry canes are often winter-killed. They may be killed to the ground, but often they are only weakened and may die any time from the start of growth in the spring until the fruit is ripening. Hot, dry weather at ripening time and the demands of the plant for water for the ripening berries and foliage are more than the winter-injured water-conducting tissues can supply. The fruiting canes dry up before the crop is mature. New shoots are uninjured and grow strongly.

Too vigorous growth, often stimulated by too much manure, heavy nitrogen applications, late cultivation, heavy fall rains and warm weather late in the fall are causes of winter-killing. Mild weather in mid- or late winter followed by sudden severe cold may cause winter-killing.

Over-vigorous growth in late fall should be avoided. Cultivation should be discontinued about August 1 and a cover crop of rye, oats or buckwheat seeded between the rows. Annual weeds will function as a cover crop. Winter-killing is usually much more severe south of New York than in the northern tier of states.

Blackberry Pests

Tarnished plant bug feeds on the blossoms so they fail to develop into normal berries. Brushy fence-rows, woods and weedy areas favor this insect. It is easily controlled by spraying with methoxychlor or a general purpose spray. Make the application just before the first flowers open and treat adjacent brushy, weedy and grassy areas as well.

Aphids distort and curl the tip leaves and should be controlled with an aphicide such as malathion, nicotine sulfate or Diazinon at the first sign of curled, distorted leaves on cane tips.

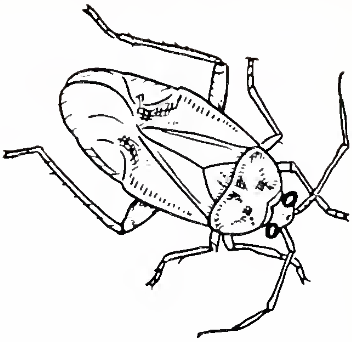
Orange rust. This systemic disease of blackberries stunts the plant severely and is diagnosed by the orange pustules on the undersides of the leaves in early summer. Infected plants must be detected early and removed or the planting will be destroyed. Wild plants nearby are a source of infection and should be removed if infected with orange rust.

Sterile flowers. A sterile blackberry clone, which blossoms but bears no fruit, has been sold for many years under various blackberry names. It should be destroyed as it will not produce any berries.

Pests of Currants

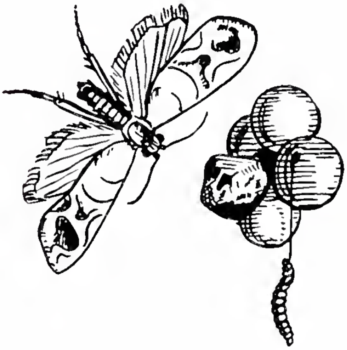
Aphids are nearly always present on unsprayed currant bushes. They distort the leaves and greatly reduce their efficiency. Some of the leaves may drop and the fruit does not ripen properly. Currant aphids can be controlled by sprays applied to the undersides when the first leaves are half an inch or an inch wide, and again right after bloom. Use an aphicide such as malathion, nicotine sulfate or Diazinon as directed.

Stem girdlers girdle the tips of new shoots which then die and fall off. The wilting tips should be removed and destroyed as soon as noticed, making the cut about 2 inches below the girdle.



Handbook of the Insect World, Hercules, Inc.

The tarnished plant bug, ¼ inch in length, is a pest of the strawberry.



The grape berry moth larva spins silken webs over grapes and destroys berries.

Currant borers burrow in the pith of the canes causing them to die. Infested canes should be removed and destroyed when discovered or at the spring pruning.

Imported currant worm occasionally defoliates currants, doing the job in a few days. Rotenone sprays should be used as soon as the worms are observed and before many leaves have been eaten.

Leafspots. They defoliate currants prematurely, but are rarely controlled.

(*Continued*)

Control is possible with bordeaux mixture, zineb, or ferbam if necessary.

Grape Diseases

Grapes in home gardens are often troubled more by diseases and insects than in commercial vineyards. In the garden they are often grown on the sides of buildings, fences or overhead trellises and are difficult to prune or spray properly. The vines are sometimes partially shaded; air circulation is poor; and the vines may be too thick. These conditions favor fungus diseases and insects.

Satisfactory control of grape troubles starts with vines growing in a sunny situation with good air circulation and proper pruning. Under these conditions spraying is most effective.

Black rot is the most serious and widespread disease of grapes in the eastern United States. The fruits begin rotting when half-grown and the berries soon become hard, shrivelled mummies. The leaves are often attacked by the fungus. Ferbam and captan are effective fungicides for black rot control. Thorough coverage and proper timing of the sprays are essential to good control.

Downy and powdery mildews are destructive to some varieties in certain areas. Bordeaux mixture will control these diseases, but may injure the vines, hence fixed copper sprays are preferred.

Grape Insects

A weevil, the grape cane girdler, lays eggs in young canes between two rows of punctures circling the stem, thus causing the tip to wilt and break. Removing and burning the injured tips should help reduce the infestation in subsequent years.

Grape tomato galls are smooth greenish or reddish swellings that appear on leaf and fruit stems. Tiny midges lay eggs in tender stems which are stimulated to abnormal growth by the orange-colored maggots developing inside. Leaves and fruit clusters may fail to develop in seasons when these insects are abundant. Spraying once or twice with malathion when the first signs of galls are seen on new leaves or fruit stems should provide control.

Grape leafhoppers suck the sap from the leaves, thereby reducing the efficiency of the foliage. The crop does not ripen properly and fruit color, sugar content and flavor are reduced in proportion to the amount of damage. The ability of the vine to withstand low winter temperatures may be reduced if leafhopper feeding is extensive. Vine vigor and cropping in future years is reduced. Since the injury is not striking in appearance it is often overlooked.

The grape berry moth causes wormy grapes. It is not serious everywhere, but when wormy grapes are numerous, control measures should be applied.

A series of treatments often are needed to control the major pests of grapes. Except against serious outbreaks of grape tomato gall or mildew, the general purpose mixture of captan, methoxychlor and malathion should give good results. Spraying when the new shoots are 6 to 8 inches long, again just before the flowers start to open, and again just at the end of blossoming is important for black rot, leafhopper and rose chafer control. Applications made when fruits are about ⅛ inch in diameter and again just as the fruits start to touch in the clusters are important to check black rot, Japanese beetle and berry moth.

Bees, wasps and birds often feed on grapes. Honey bees apparently feed only on grapes that have cracked or have been damaged by wasps and birds. The simplest method of preventing damage is by enclosing the grape clusters in paper sacks as soon as the fruit begins to color. The No. 2 size sack is large enough for most varieties. Only white paper sacks should be used as the brown paper imparts a very unpleasant flavor to the fruit. The sack is pulled up over the cluster and fastened at the top with a stout pin. It is advisable to cut off the lower corner of the sack to permit rain water to drain away. ◆

WEED CONTROL WITH HERBICIDES

Otis Curtis

CONTROLLING weeds (unwanted plant growth) with chemicals (herbicides) is not a panacea. The use of herbicides involves more than waving a spray wand, or tossing a few handfuls of granules. Care is needed in calculating and applying the correct dosage. A mistake in hoeing or cultivating can cripple a few crop plants, but a mistake with herbicides can be a calamity for the entire planting. For a half dozen trees or the small berry patch, the hoe is still generally a simpler expedient than the weed-killer spray.

No single crop herbicide will kill all weeds. All herbicides must be selective in that they are harmless to some plants including, of course, the crop itself. Complete freedom from weeds can result from use of various herbicides, but it is more realistic to expect to do some supplementary weeding with hand or hoe. The reduction in weed population will make such touch-up weeding easier and more effective. Those who are experimentally minded can learn by leaving some untreated "check" plots to compare with the herbicide treatment.

The herbicides to be considered here are those that are not only useful for several fruit crops, but also have other possible uses around home grounds. (For more complete information on herbicides for fruit crops the reader should consult the cooperative extension service of his county or state.) Herbicides that are useful on only one or two crops, or appropriate only for special weed problems in a few crops, are omitted by intent. A cupboard full of various herbicides, each safe on one crop but not on others, some used by teaspoon rates and others by pounds, is an invitation to trouble in the home garden.

Useful Herbicides

The following three are active in the soil, where they prevent the germination of weed seeds, or kill the seedlings as they sprout. The duration of preventative weed control ranges from one to four months through the growing season. Practical control is often longer if new seed is not brought to the surface of the ground by cultivation or dropped from nearby mature weeds. Perennial weeds like thistles and bindweed with underground storage organs, or with far-reaching horizontal root systems that form new plants readily, are usually not controlled if already present on the site. The herbicides below are marketed both in a granular form, which is spread like fertilizer (but usually at much lighter rates), and as powders that are to be mixed with water for spraying.

Simazine (Princep*)—Used at rate of 2 to 4 pounds active ingredient per acre. It is used extensively by commercial fruit growers and in nurseries of woody ornamentals. It provides preventative control of most weeds that start from seed. Weeds that have started, but are no more than 2 to 4 inches high, are also controlled to an appreciable degree. The time of application is usually late fall or early spring. Summer application is likely to be disappointing unless weeds already-in-growth are removed by other means.

Dichlobenil (Casoron*)—Used at rate of 4 to 6 pounds active ingredient per acre. It provides preventative control of some perennial weeds that sprout from underground storage organs, as well as of weeds that start from seeds. Quackgrass, the bane of so many Northeast gardeners, is one of the perennials controlled. Application can be made at any time between November and April when the ground is unfrozen. A consideration in timing is the fact that, if daytime temperatures rise above 55°F for a few days before rainfall carries the chemical into the soil, much of the chemical may be lost by evaporation from the soil surface. In warm weather this loss can be avoided by irrigation, or by mixing the chemical into the soil by cultivation or raking.

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* Trade names are supplied for convenience of the user. Criticism of unnamed products is not intended.

DCPA (Dacthal*)—Used at rate of 9 pounds active ingredient per acre. It is a strictly preventative herbicide that controls only weeds that start sprouting from seed after it is applied. Among the weeds controlled are those ever-present garden weeds—crabgrass, foxtail, purslane, and pigweed. Some common weeds, including ragweed, are poorly controlled. A combination of DCPA and sesone, which may be available in the future, will control a broader range of weed species. The only use of DCPA in commercial fruit growing is for strawberries; but it has other uses for plant growers, including crabgrass control in lawns, and preventative control among woody nursery plants and ornamentals.

The following two herbicide sprays act as contact killers of most plant parts that they wet. They kill current weed growth, which means an outright kill of most annual weeds, and control perennials at least to the extent of killing back the above-ground parts. Either one may be used instead of a preventative herbicide, or as a supplement to treat weeds that have survived the preventative treatment. When used alone, they have the disadvantage of requiring two or more applications over the season as successive crops of seedling weeds emerge. But they have an advantage in flexibility; they can be applied only if and where there are weeds to be controlled. They give the user the satisfaction of viewing dead weeds a few days after application. And, they free the user from the need for careful attention to spray volume. Spraying to "wet the weeds," which can lead to grave mistakes with most herbicides, has some validity when one is using fuel oil or paraquat.

Fuel oil (No. 2 Fuel oil, Diesel fuel)—Shows effects on weeds within minutes after spraying, and evident kill within days. Some weeds, as ragweed and wild carrot, are resistant. Most grasses, including quackgrass and orchard grass, are killed to the ground. They recover eventually, but control is as lasting as after hoeing. For maximum control of grass the oil should wet the lower stems thoroughly.

The bark of trunks and exposed roots *should not* be sprayed with fuel oil. It can penetrate and injure the cambium, with damaging results that are not immediately evident but may lead to girdling of the trunk. To avoid this possibility, it is worthwhile to leave a fringe of grass next to the trunk for hand-pulling, or to wrap the trunk with foil or other protective covering. Oil does kill quackgrass when only the base of the stem is wet. Consequently, control of grass can extend close to the trunk without actually wetting the trunk.

The fire hazard of oils should be kept in mind. Straw mulch and matted dead vegetation are more inflammable for a brief period after spraying. Another problem sometimes occurs when rubber parts of sprayers swell under continued contact with oil. Disassembling and allowing them to "dry" in the air for a few days is the remedy.

Paraquat—At ½ to 1 pound per acre in sufficient water to wet the weeds lightly, and with an added wetting agent, kills weed growth within a few days. It is less damaging than oil to tree trunks, and is generally safe on intact bark of trunks two years old or older.

The prospects for paraquat for the amateur grower are uncertain. The commercial concentrate (2 pounds per gallon, or enough to kill 2 to 4 acres of weed growth) is too toxic to be used around homes. In New York State it is available only to commercial growers who have obtained permits to use the most toxic pesticides. If more dilute preparations do come on the market they will carry directions for home garden use. Check with county agents for further information.

The suggestions in the table below are simplified. *Read the label* for complete directions and precautions. Do not vary recommended dosages.

CROP USES

TREE AND BUSH FRUITS—Apple, Cherry, Peach, Pear, Plum, Grape, Blueberry, Blackberry, Raspberry

Preventative Treatments

Simazine (Princep*)—Use as spray (80W) or in granular form (4G).

80W: 1½ to 3 level teaspoons (2½ to 5 grams) per 100 square feet.
1 to 2 ounces (26 to 52 grams) or 4 to 9 level tablespoons per 1,000 square feet.

4G: 2 to 4 ounces (52 to 104 grams) per 100 square feet.
1¼ to 2¼ pounds (520 to 1040 grams) per 1000 square feet.

Apply in spring or fall, or apply low rate in both spring and fall. In the year of planting use the low rate and be sure soil is firmly ridged against the trunks or canes. Use *no more* than the low rate on sandy soils or under stone fruits. Contact on foliage by spray or granules is usually harmless.

Dichlobenil (Casoron*)—Use granular form.

G-4: 4 to 5½ ounces (104 to 156 grams) per 100 square feet.
2½ to 3½ pounds (1040 to 1560 grams) per 1000 square feet.

Apply between late fall and early spring when ground is unfrozen but daily temperatures are not rising above 55°F. For raspberries and blackberries use lower rate and preferably apply in fall.

Treatment on Growing Weeds

Fuel Oil (No. 2 or Diesel)—Spray to wet the weed growth, or at 1 pint to 1 gallon per 100 square feet depending on density and height of weeds. Aim to wet the base of grass clumps thoroughly. *Avoid* wetting trunks or canes; the bark of stone fruits is particularly susceptible to injury.

Paraquat—Follow directions on container. Avoid wetting the bark of trunks or canes less than two years old.

STRAWBERRIES

DCPA (Dacthal*)—Use as spray (W-75) or in granular form.

W-75: 4 level teaspoons (12½ grams) per 100 square feet.
14 level tablespoons (125 grams) or 4¼ ounces per 1,000 square feet.

5-G: 6½ ounces (190 grams) per 100 square feet.
4 pounds (1900 grams) per 1,000 square feet.

2½G: 13 ounces (380 grams) per 100 square feet.
8 pounds (3800 grams) per 1,000 square feet.

Apply after setting and again in midsummer after removing growing weeds. Follow with early spring application (certainly before bloom) and a midsummer one in succeeding years. DCPA could be used in the same pattern for weed control in nursery plantings of young fruit trees and bushes.

Marjorie J. Dietz

The owners of a vacant house lot which adjoined their property have converted it into a dwarf fruit tree orchard. While the weed growth under and around the trees is picturesque, the recommended practice is to remove sod or weeds under trees by cultivation or use of herbicides.

The amounts to use on 100 square feet, as well as for 1,000 square feet, are shown above because relatively small areas are treated under fruit trees. If a square of 4 feet by 4 feet is treated under each tree, the amount for 100 square feet will treat 6 trees. It will treat 3 trees if spread on 6- by 6-foot squares. If a continuous band is treated, as would be done in berries, grapes, and closely-planted dwarf trees, 100 square feet would occupy a band 4 feet wide (2 feet on each side of the row) by 25 feet long. The amount of granules for the low rate of simazine on this area will seem small. It *is* small, and must be spread carefully to give uniform distribution over the area. For small plots, a shaker may be improvised by punching holes in a can by trial and error until the rate of delivery is suitable. Lawn spreaders can sometimes be adapted for band treatment with granules. Or, a gloved-protected hand may be adequate if used carefully to ensure uniform distribution of the granules.

Spray rates for preventative sprays do not mention the volume of water because the effective dose is the amount of product left on an area, regardless of the amount of water used to put it there. A convenient amount will probably be in the range of one to four pints for 100 square feet, or one to four gallons for 1,000 square feet. But, the volume of water to be sprayed per unit area must be known before the herbicide mixture is sprayed on the crop. One way to learn this is to spray a definite area in the same fashion as the weed spray is to be used, but with water, and determine the volume of water used. The calculated amount of herbicide for that area is then mixed with the determined amount of water. A record should be kept of the area sprayed and the amount of product used on it. If the actual spray applied is discovered to be much less than planned, more spray can be applied. If it is more than planned, this knowledge will give a basis for evaluating eventual results.

Very low pressures are adequate for these herbicide sprays. Sprinkling cans may serve well for applying the preventative herbicides provided the amount of water used on an area is determined as in the previous paragraph. Spray mixed of simazine or DCPA should be shaken occasionally to avoid settling in the spray can and consequent uneven distribution of the chemical on the sprayed area. ◆

TROPICAL AND SUBTROPICAL FRUITS

H. S. Wolfe

THE only truly tropical area—one that never experiences frost—in the United States is on the Florida Keys. Many typical fruits of the tropics are grown, however, in the southern part of the Florida peninsula, especially near the coast from Palm Beach and St. Petersburg southward. The area suited to subtropical fruits is much more extensive, reaching its northern limits along the Atlantic coast in Virginia and extending southward along the coastal plain to southern Texas, then leaping across to southern California and adjacent Arizona. Not all of this area is equally suited to all fruits. Some thrive only in the warmer half of this area, while others flourish in the cooler part.

In general, all tropical fruits—citrus, fig, avocado, mango and others—require about the same sort of attention to fertilizing and pest control as do northern fruits, but they do not usually respond profitably to the intensive training and pruning given apples and peaches. Most of the plants are evergreen and make three flushes of growth each year. It is customary to apply fertilizer to bearing trees just ahead of each flush, usually in February, June and October in Florida. Young trees not yet in bearing are fertilized more frequently, about every 6 or 8 weeks, and papayas thrive best if fertilized biweekly.

Since Florida soils are usually very low in mineral nutrients, it is customary to use in home gardens a fertilizer mixture analyzing 6% N (nitrogen), 6% P_2O_5 (phosphorus pentoxide), 6% K_2O (potassium oxide) and 3% MgO (magnesium oxide). Such minor elements as zinc, manganese, and copper are frequently deficient in these soils, but are more readily available to trees as sprays than from soil applications.

Soil management practices in Florida call for growth of green manure crops during the summer months when rainfall is ample for both trees and cover crops, and mowing or disking down the green manure crop in the fall. Irrigation is often beneficial during the winter or spring months, when there may be a period of several weeks with little rain, but is not regularly practiced in commercial orchards. Mulching is a very desirable practice for home orchards of tropical and subtropical fruits if a supply of organic mulch can be obtained reasonably. However, when frost threatens, the mulch should be raked out from under trees. The sandy soils of Florida are not well buffered and tend easily to become too acid from fertilizer or spray residues. Use of dolomitic lime to maintain the pH between 5.5 and 6.0 is an important practice. On the calcareous soils where avocados, limes and mangos are principally grown, control of pH is not possible. Heavy organic mulches and minor element sprays keep trees in good health when used with ordinary fertilizers.

Citrus Fruits

Best known and most important commercially among subtropical fruits are the orange, grapefruit, lemon and tangerine. They are suited to the warm subtropics (and to the tropics also), and are chiefly cultivated in central and southern Florida, the Rio Grande valley of Texas, and southern California and Arizona. Lemons are a little less hardy to cold than are the other three, but while their commercial production is greatest in California, there is much acreage in Florida, and they may be grown for home use in all the above areas of citrus culture.

Satsumas, kumquats and calamondins are citrus fruits able to endure a few degrees more of cold than oranges, and so are grown in northern Florida and southern Alabama, Mississippi and Louisiana. Limes, on the other hand, are tropical fruits and grown extensively only in southern Florida, with some culture in the warmest parts of California and Texas. The calamondin is essentially an unusually hardy lime, and is grown only for home use.

All citrus fruits, except the lemons and limes, have a long period of time during which any individual fruit may be harvested. Usually it is at least three months from the time a given variety reaches good eating maturity until it is definitely over-mature. Thus, a few fruits may be picked daily over several months. The lemons and limes are picked immature, but their repeated blooming makes their fruit constantly available. An item of unusual importance with all citrus fruits is the rootstock employed. In general the sour orange stock is satisfactory for most citrus fruits on soils of good moisture content, while 'Rough' lemon stock is more satisfactory for well drained sandy soils. There are several special cases of adaptation of scion to stock, however, which make neither of the above stocks satisfactory. Thus, the satsuma is satisfactory only on the trifoliate-orange (*Poncirus trifoliata*) as stock, while 'Temple' has much better quality on 'Cleopatra' than on 'Rough' lemon stock.

Varieties of orange are far fewer than those of apple or peach, although commercial orange production far exceeds that of the apple, and half a dozen varieties make up 95 per cent of production. 'Valencia' is the leading variety in all the orange-growing states (except for the spring and summer. 'Washington' navel is the other leading variety in California for fall and winter, while in Florida and Texas several varieties mature in sequence in this period. Grapefruit varieties have less variation in maturity, and are divided into seedless and seedy. 'Marsh' is the leading seedless variety, with several red- or pink-fleshed sports quite popular, such as 'Ruby.' 'Duncan' is the chief seedy variety and the standard of quality. 'Dancy' is the best known tangerine, coming to markets for Christmas; 'Robinson' is a good variety for late fall.

Often classed with oranges for convenience are some hybrids between orange and tangerine, the tangors. The so-called 'Temple' orange is one of these, and is considered as unsurpassed in flavor among oranges when well grown. Its season is late winter. Another interesting group of hybrids is the tangelo, the result of crossing tangerine and grapefruit. Some tangelos are like very juicy oranges while others are rather tart, but all are tasty. Among the best are the mid-winter maturing 'Minneola' and 'Seminole.' 'Cleopatra' stock is preferred.

The commercial lemon varieties, 'Eureka' and 'Lisbon,' are best for home use in California, while 'Meyer' is a strictly home lemon, grown in Florida, Texas and California and orange-colored in rind and flesh color. The chief lime variety of Florida is the 'Persian' ('Tahiti'), which is green and seedless, and this is also the lime of California (as 'Bearss'). Texas and the Florida Keys grow the seedy 'Key' or 'Mexican' lime.

Fig, Kaki, and Lychee

Typical fruits of the cool subtropics are the fig and kaki, or Oriental persimmon, which do best north of the areas of satisfactory citrus culture. Both are deciduous in winter and mature their fruit in summer and fall. For the most part, no pollination is required for fruit setting in the varieties grown for home use. No systematic pruning is practiced in the home orchard. They are fertilized like other deciduous fruits.

Figs are troubled greatly by the rootknot nematode, especially on sandy soils, and must be heavily mulched in the garden to avoid attack. They are propagated only by cuttings. 'Celeste,' 'Brunswick,' and 'Brown Turkey' are leading varieties in the Southeast, while the latter two plus 'Kadota,' 'Adriatic,' and 'Mission' are all popular in California.

Oriental persimmons are about like apples in range of fruit size and are bright yellow-orange to orange-red in color. 'Tanenashi' is the chief variety in the Southeast, and 'Hachiya' in California;

both are large and seedless and need no pollination. A few varieties needing pollination are sometimes grown. All kakis are free from astringency when soft and ripe, but most seedless ones pucker the mouth until they are fully ripe. 'Fuyu' is an unusual variety which is never astringent at any stage of maturity. Kakis are grafted on seedling stocks of several species: in Florida and Texas the native persimmon is used, while in California, seedlings of the kaki and of the Chinese lotus persimmon are preferred. In the South, kakis are rather short-lived.

The lychee is a fruit of the warm subtropics which has recently been planted commercially in central and southern Florida. The fruits mature in June and look like large ripe strawberries; they have a brittle red shell around a glistening white pulp of delicious flavor. The tree is propagated only by air-layering but is easily grown. The dried fruits, resembling raisins in a thin shell, have long been imported from China as lychee "nuts." The 'Chen,' or 'Brewster,' is the common variety.

Avocado

Avocados are derived from three wild races with different climatic adaptations. The Mexican race endures as much cold as the orange, the Guatemalan race is about as hardy as the lemon, and the West Indian race is more like the lime in cold tolerance. Florida grows varieties of the latter two races and of crosses between them, while California grows the first two races and their hybrids. In California it is possible to have fruit maturing every month in the year, while in Florida fruit may be had from June until April or May. Very few varieties are common to both states, and many different varieties are grown. 'Fuerte' and 'Hass' are the leading varieties in California, while 'Ruehle,' 'Waldin,' 'Booth 8,' 'Booth 7,' and 'Taylor' give a fruiting sequence in Florida from July to January.

The avocado fruit is rather unusual in having the stored food chiefly in the form of fat, instead of as sugar or starch. Like citrus fruits, avocados can be left on the tree for weeks after they first become edible, and they never ripen on the tree. Indeed, they improve in quality for home use the longer they hang, although there is steady loss by droppage. In Florida there is often failure to set a good crop for lack of pollination if a single tree is planted, but this seems to be a less common trouble in California. Avocados are budded or grafted on vigorous seedlings.

Paris Trail for N. Y. S. Agric. Exp. Station

The fig loses its foliage in winter. The fruits ripen in summer and fall.

Mango

One of the best tropical fruits is the mango, which can be considered the "peach of the tropics" as it matures in the summer like a peach. Many seedling trees have fruit filled with stringy fibers, but the cultivated varieties are as free from fiber as peaches. Like peaches, again, the mango softens at full maturity on the tree and drops, so that picking must be done every few days. Some mango varieties are among the most beautiful fruits in the world, combining red, yellow and purple, while others are modestly yellow or even green at ripeness. Occasional mango trees are found in the warmest parts of Texas and California, but their culture in this country is really satisfactory only in southern Florida.

Trees are propagated by budding or grafting and are rarely pruned. Bees are very helpful in pollinating the flowers for fruit set. The varieties 'Zill,' 'Irwin,' 'Kent,' and 'Keitt' provide a sequence of fruit from late May to early September.

Papaya and Guava

The papaya is a most rapidly maturing fruit tree; it is a giant herbaceous plant with no true woody tissue. The fruit resembles a melon, both in appearance and in taste, and may be from 1 to 15 pounds in weight. At about five months from seed the tree begins to produce flowers, and thereafter for many years (unless cold kills it), a flower develops in the axil of each new leaf. The stem usually does not branch, and so after several years the fruiting area is many feet from the ground. Usually new plants are set after a couple of years of bearing. The first fruit is usually matured in less than a year from seed. Some varieties have perfect flowers, while others have female flowers and must have a male tree to pollinate them.

The guava is a fruit widely cultivated in the tropics, not so much as a dessert fruit as for the jelly which is so easily made from it. There is great variation in guava sizes, and some of the larger types (weighing over half a pound) are fine for canning as guava halves. This fruit is unusually high in vitamin C content, the average value being several times that of oranges, and guava jelly retains much of this. Some guavas are usually found maturing from off-season bloom at almost any time of year, and certain types mature chiefly in winter, but the main season of maturity is late summer. Until recently propagation was chiefly by seed, but air-layering makes propagation of named varieties easy for the home gardener, while veneer-grafting is now possible for the commercial propagator.

Novelty Fruits

The home gardener may choose from a great number of non-commercial fruits, grown purely for novelty and interest. Some of the most desirable species are briefly described. All are evergreen trees or shrubs.

Loquats have juicy, sweet, acidulous fruits the size of olives, borne on a handsome tree and maturing in late winter. While the trees are hardy even north of Florida, fruit production is more regular in warm areas.

Several guava relatives have tasty fruits but do not endure much cold. One of the best is the grumichama, with nearly black fruits somewhat like sweet cherries. These ripen in April and May, only a month after blooming, and taste best if allowed to become very fully ripe. Better known is the pitanga or Surinam-cherry (*Eugenia uniflora*), borne on a handsome shrub popular for hedges. Two seedling races are grown, one with bright red fruits and the other—the black form—with very dark maroon color. Both are juicy, sweet, and acidulous, but must be fully ripe. Lack of soil moisture prevents good quality. Again, the time from flower to fruit is only a month or so, with most of the crop in late spring. The jaboticaba (*Myricaria cauliflora*) has fruits somewhat reminescent of muscadine grapes, and is exceptional in that often there are three or four successive crops during the spring and summer. The fruits are mostly borne directly on the trunk and branches inside the canopy. The Cattley guava is a large shrub which bears an abundance of tasty fruits about one inch in diameter in late summer. There are seedling races with either red or yellow fruit. This species is as hardy as oranges. All of these guava relatives are esteemed for jelly-making, as well as for eating fresh, and are propagated by seeds.

The *sapodilla* tree is a handsome ornamental for its foliage, although neither flowers nor fruits are showy. It is very tender to cold, but very resistant to storm winds. The scurfy brown fruits have a yellow-brown flesh like a pear in texture, but are sweet without any trace of acidity. Seedling trees usually have fruits less than 2 inches in diameter, but nurseries now propagate the variety 'Prolific' with larger size. ◆

BIRD DAMAGE TO FRUIT CROPS

R. D. Way and J. A. Sherburne

MANY techniques to prevent birds from destroying fruit crops have been tried but, thus far, the only practical measure to assure protection from birds, at least in the small home garden, is to cover the plants with a net.

Every year birds destroy large quantities of cherries, blueberries, and grapes. They also cause a great deal of damage to peaches, elderberries, strawberries, pears, raspberries, apples, currants, plums and other fruit crops. Bird damage to sour cherry, one of the most important fruit crops in several northern states, results in tremendous economic losses.

The extent of fruit damage due to birds varies from year to year. Because of different weather conditions, varying food supplies, and other factors—some not fully understood—damage may be ten times greater one year than another. Damage caused by pecking and puncturing of fruit skins is often greater than damage caused by the actual eating of fruits.

Research being currently conducted at Cornell University indicates that birds exhibit preferential selection when feeding on fruits. For example, extensive damage has occurred on one variety of pear and very little on another variety, fruiting in the same orchard. Early-ripening varieties of black sweet cherries are especially susceptible to bird damage. Some possible explanations for this selective behavior are presently being investigated by the junior author and will be discussed under the section on Repellents.

A large number of different kinds of birds are responsible for damage to ripening fruit crops. Among the most destructive are starlings, robins, orioles and cedar waxwings. Serious fruit destruction has also been caused by crows, sparrows, and red-winged blackbirds. Blueberries have been found in the stomachs of 93 kinds of birds. In some fruit plantings starlings may be the most plentiful species, in other plantings, sparrows.

Bird damage to fruit in small plantings is often more noticeable than that in large plantings. In fact, large fruit plantings usually suffer a smaller percentage loss due to birds than small plantings. In most large commercial cherry orchards, the grower seldom suffers a loss of more than half his crop, but individual cherry trees in backyards frequently lose nearly every cherry before they ripen.

Methods of Control

In large commercial plantings, some of the most successful, large-scale techniques are genuinely workable deterrents and are of tremendous economic benefit to the fruit grower. However, thus far, the only completely sure method of preventing bird destruction on fruits is to physically obstruct the birds from getting at the fruit, which has met a limited degree of success at best and is expensive for the large grower. Cloth netting over an individual blueberry bush is a very practical solution for the home gardener. Twenty blueberry plants can be profitably covered with a cage of chicken wire. Half-inch-weave netting made of water-proof paper fabric is less expensive than cloth or wire netting. Placing white paper bags over clusters of grapes or individual prize specimens or branches of fruit is also a very practical method in deterring birds on a small scale.

Many other methods of controlling birds in fruit plantings have been tried. Most of these methods involve killing or frightening the birds. *Discussion of certain drastic measures here does not necessarily mean that they are recommended for use and, in all cases, one must abide by state and local laws which govern the killing of birds or the making of noises.* When the present concern by the public over the ecological balance (or imbalance) is considered, *any* drastic measures must be suspect. *Investigations in control measures that benefit the grower or gardener, which at the same time offer little or no threat to the involved pestiferous bird species, have to be continued.*

Methods which depend upon the mass killing of destructive birds are biologically unsound and thus are generally ineffective. The proportion of a bird population for a given area that would have to be eliminated to produce reduction of fruit damage is impractical, if not impossible, and would undoubtedly upset the ecological balance of the area as well as those persons not involved with growing fruits.

Despite the invention of new techniques to control birds, shooting starlings

Why Fruit Trees Fail to Bear

Age: The trees may not be old enough. Apples on seedling rootstocks usually do not produce much fruit until they are 6 or 7 years old. 'Northern Spy' may not begin fruiting until 10 or 12 years old. Dwarf apple trees, especially on Malling IX rootstocks, can produce fruit at 2 or 3 years of age.

Pears may bear slightly earlier than apples, peaches at 3 years, and sour cherries about the same. Sweet cherries begin at 5 to 7 years and European plums when 5 or 6 years old. The Japanese plums fruit a little earlier.

Unfavorable weather: Minimum temperatures in the winter may kill the fruit buds. Peaches and sweet cherries are especially susceptible to injury from severe cold in the winter.

Frost during the blooming period, especially in frosty locations, may destroy the blossoms. Apricots, peaches and sweet cherries, all early blooming, are especially susceptible to frost when in blossom.

Cold, windy and wet weather may prevent the bees from flying during fruit bloom so the flowers are not cross-pollinated. Many fruit varieties are self-unfruitful and require cross-pollination with another variety if the blossoms are to set fruit. The bees provide for cross-pollination.

Self-unfruitfulness: Self-unfruitful varieties do not set fruit when self-pollinated. Another variety must be nearby to provide compatible pollen. If only one variety is set in a home garden, and there are no other varieties nearby, very little fruit will set. Most peach varieties and some plums are self-fruitful. Japanese plums are self-unfruitful and are not pollinated by European plum varieties, so two varieties of Japanese plums must be planted. Most grapes and the small fruits are self-fruitful. Blueberries are partially self-fruitful, but produce larger berries and heavier crops if cross-pollination is provided.

Nutritional condition of the Tree: Trees that are excessively vigorous may be slower in coming into bearing while low vigor may delay fruiting or cause light crops. Low vigor may be caused by poor drainage, lack of nitrogen, injury from diseases or insects. The reduction of leaf area from apple scab, or reduce defficiency of the foliage from mites, aphids, or leaf-hoppers, may reduce next year's crop.

Fruit plants require full sunshine all day long, and if they are growing in a shady situation, fruiting will be greatly reduced. The light crop and poor color of the fruit borne in the interior of a dense tree is an example of the injurious effect of shade or inadequate sunlight. —*G.L.S.*

in large orchards is still very practical, and of little danger to the species, since we have very possibly increased the starling population with the advent of monoculture crops. Here, shooting does not materially reduce the size of the population, but it is primarily a technique of frightening other starlings.

Scarecrows

Scarecrows with power-driven moving arms are useful, but periodically, they must be the farmer in disguise or the birds will learn to be unafraid of them! In any case, scarcrows must not be constructed too early in the season; their effectiveness depends on birds being frightened at the critical stage when the fruit is ripening.

Noise makers of many types have been used with varying success. As early as 1614, Gervase Markham in England wrote, "You must have some boy or young fellow that must every morning from the dawning of the day till the Sunne be more than an houre high, and every evening from five of the clocke till nine, runne up and downe your ground, whooping, showting and make of a great noyse, or now and then shooting of some Harquebush, or other Peece: but by no meanes to use slings or throwing of stones, least by miscarriage of his hand hee either beate down the fruit or bruise the trees."

Even today, making noises in the orchard is still one of the most effective means of controlling birds. Some commercial sweet cherry growers find it profitable to drive their cars, blowing the horn, through the orchard several times daily just before harvest. A car without a muffler is also useful. Although flocks of birds generally fly away because of this noise, they also usually return quickly!

Exploding devices of several types have been used with considerable success. Gas-powered cannons, machines attached to acetylene tanks or generators which explode periodically, resembling the shot of a gun, have been manufactured specifically for the scaring of birds. Robins, however, soon become accustomed to these and sometimes perch fearlessly near the devices while they are exploding. Firecrackers attached along a dangling fuse which burns slowly are effective in causing a loud report every few minutes to scare birds from a fruit planting. Aerial bombs throwing missiles which, in turn, explode while in flight are also effective.

A cat which is accustomed to a collar tied to a string can be very useful in a small strawberry patch to frighten birds away. Cats have been placed in a cage in a cherry tree in an attempt to save the crop!

Birds fear the image of a hawk. In Holland, a stuffed hawk tied to a nylon string 100 feet long and whirled over a cherry orchard from a tower prevented damage to 8 acres of cherries.

Cross-hatching of twine over berry bushes confuses birds when it is first erected and in their confusion they stay away, but they soon learn how to fly down through between the twines. Mist nets of very fine strong thread have been used successfully over highbush blueberries, but most home gardeners will be repelled by this method when they have to extricate dead birds caught in the fine threads.

Repellents

The use of repellents has been tested extensively. Devices to repel birds from a fruit planting can be based on the various senses of the bird: sight, taste, smell, hearing or touch. Visible patterns such as eye-like patterns on large butterflies are frightening to birds. Experiments have shown that birds can taste with as much sensitivity as any other veterbrate. If ripening fruits could be sprayed with a chemical which was offensive to birds, this might be very useful. Effective chemical repellents must be non-toxic to man; they must not spoil the taste or appearance of the ripe fruit; they must retain their effectiveness for reasonable periods after application; and they must be inexpensive and easily applied. These specifications for effective chemical repellents are so exacting that progress along these lines appeared difficult because of the specifications outlined above. For several years, workers investigated many synthetic chemicals that could be applied as repellents. However, essentially little work was done to learn why birds preferred some fruits over others, and why birds obviously avoided unripened fruits. The reasons why birds prefer some ripened fruits over others has been shown within the past two years to involve such things as relative abundances of fruiting species, time of ripening, and color of fruits. However, nearly all birds wait until fruits are ripened before eating them; rarely are green fruits eaten.

While most plants depend upon some agent other than birds to disperse their seeds (wind, water, the absent-minded squirrel) many woody plants have gone to the expense of producing a fruit which surrounds the seeds. This fruit serves no apparent purpose other than attracting birds which will ingest it and harmlessly deposit the seeds elsewhere. However, it would be no advantage for one plant to produce a fruit that would be eaten prematurely; before the seed had matured. It is possible that while evolving a fruit which birds would eventually utilize, the plant also had to produce a defense against premature predation and against predation by seed-eating birds. The junior author is presently investigating such a possibility of a chemical defense by one plant. If some plants contain a chemical deterrent, perhaps this chemical could be applied to the fruits of plants which have no such means of protection, thus repelling pestiferous birds while meeting the specifications outlined above.

The sense of touch in birds has been effectively employed. Wires coated with an adherent gummy material and stretched high over vineyards have been effective in repelling birds. Birds first perch on the high wires before dropping down into the vineyard to feed; the gummy substance on their feet frightens them away.

Spirolum whirlers, made of shiny foil similar to those used in advertising by gasoline stations, have been effective repellers when stretched over blueberry plantings. However, birds soon become accustomed to these; they quickly lose their effectiveness. Strips of aluminum foil tied to limbs of trees of ripening cherries have a similar effect.

In Germany in an area where large flocks of starlings roosted in fields of reeds near cherry orchards, the birds did not return after they had been driven out three successive evenings by helicopters equipped with flashlights flying over them.

Orchard Location

The location in which commercial fruits are planted can be an important factor in the control of birds. Cherry orchards and blueberry plantations which are near a woods are particularly susceptible to bird damage as the birds use the woods for hiding. Hedges growing near small fruit plantings provide a hiding place and the fruit is vulnerable to bird damage. Birds prefer ripe mulberry fruits to sweet cherries which ripen about the same season. A large fruiting mulberry tree near a cherry orchard has been known to tend to prevent bird damage to the cherries. Unfortunately, the home gardener has little choice in selecting sites for his fruits.

Bird traps have been used successfully. Their success is dependent on the proper choice of baits which attract mainly the destructive species. Traps constructed of wood frames 9 feet square and 7½ feet tall and covered with chicken wire have been useful during harvest season in catching thousands of starlings in cherry orchards in New York and Ontario. Traps are expensive to operate because they must be visited daily. Traps made of netting in the shape of a large funnel with a strong light at the bottom of the funnel used at night have made it possible to catch thousands of birds at a time.

Phonograph records of distress calls of starlings have been made. Amplified and replayed back into the orchard, the recordings frighten starlings away. Species other than starlings are not frightened by the starling call. Even starlings become accustomed to the call and after two weeks of use, its effectiveness may diminish. In England where the use of distress call recordings is illegal, recordings of the flapping of wings such as that heard by a flock of birds flying up in unison from a field have been effective.

Electric shocking devices which do not kill the birds, installed on posts above a field over fruit plantings are effective in disrupting birds approaching a fruit planning. This technique has been used in commercial elderberry plantings in New York.

Fruit growers have no desire to indiscriminately kill large numbers of birds. Their only purpose in controlling birds which destroy their crops is to try to obtain the most profit for the fine fruit which took so much care to produce. Sometimes the fruit growers' purposes conflict with those of the conservationist. It will be necessary for both interests to compromise in order to solve the problem. ◆

Where to Learn More About Fruits

THE American Pomological Society (headquarters: Department of Horti-ture, Pennsylvania State University, University Park, Pa. 16802) has since 1946 published a quarterly magazine, *Fruit Varieties and Horticultural Digest*. Here, the originators of new fruits describe and evaluate their finds. The magazine is a clearing house for information about new and old varieties.

The New York State Fruit Testing Cooperative Association, Inc., Geneva, N. Y. 14456 was organized in 1918 to introduce the new fruit varieties originated at the New York State Agricultural Experiment Station. It also distributes new varieties developed at other experiment stations in the United States, Canada and abroad. Old varieties of special merit, some of which are no longer available from commercial nurseries, are occasionally made available to fruit growers by the Association. It has a membership of about 5,000 in all 50 states and many foreign countries.

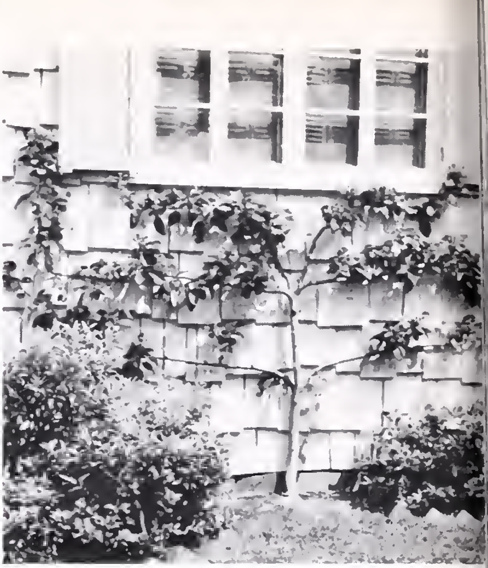
Other activities of the Cooperative Association include maintenance and distribution of virus-free plants of strawberries, raspberries and cherries; the use of new size-controlling rootstocks as they become available; and the propagation of grape vines on phylloxera- and nematode-resistant rootstocks.

The annual catalog prepared by the fruit breeders at the New York State Agricultural Experiment Station, Geneva, N. Y. 14456 contains much information on new fruit varieties.

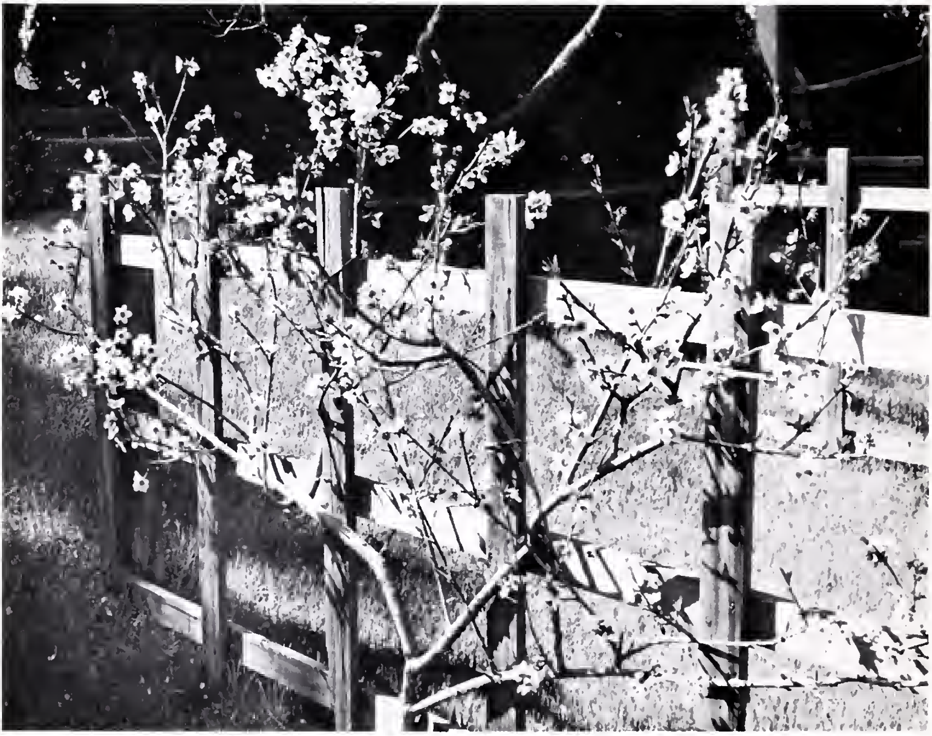
The Agricultural Extension Service which operates at the state colleges of agriculture in every state and in most agricultural counties, usually at the county seat, is also a good source of information about fruit culture. Publications and advice from fruit specialists may be had at all extension service offices. The best information is likely to be in states and counties with a considerable fruit industry. Insecticides, fungicides and herbicides are changing frequently, and the latest recommendations concerning them should be sought each spring before use.

Finally, the Office of Information, United States Department of Agriculture, Washington, D. C. 20250 has many publications on fruit-growing, as well as personnel to answer inquiries. ◆

Roche



George Taloumis



Roche

IDEAS FOR GROWING FRUITS IN THE HOME GARDEN—*Top left:* Variations on the strawberry barrel. This one contains strawberry plants of the 'Baron Solemacher' type which can be grown from seed. *Top right:* An espaliered apple grows against a house wall. *Above:* A peach has been trained in espalier fashion against a fence.

Virus-Free Fruit Plants

PLANTS of many varieties of fruits, especially the small fruits and stone fruits, are known to be infected with one or more of several viruses. Some of these viruses have serious effects on the host plant. Plants affected with some viruses have very distinct symptoms (such as mottled foliage or stunted or deformed growth) and become greatly reduced in vigor and fruitfulness. Some viruses produce no recognizable symptoms, but still reduce plant vigor slightly. Combinations of viruses usually have serious effects on the host plant.

Some viruses are easily identified by their effects on the host. Others that produce no visible symptoms are identified by transferring the virus to a test plant which will exhibit definite symptoms when the virus becomes established in it. The test plant is known as an indicator plant. Transferring the virus to an indicator plant is called indexing.

Many indicator plants are used, but a fast growing annual, *Chenopodium quinoa,* gives quick results and is one of the most useful for detecting the presence of several viruses.

When it became evident that virus-free plants were much superior in vigor and fruitfulness to the virus-infected plants, steps were taken to locate, index, propagate and distribute virus-free stocks. Plants from many sources were tested and, if found to be virus-free, were propagated and distributed. However, no virus-free plants were found of many good old varieties. It was then discovered that viruses could be inactivated by growing the infected plants at a temperature high enough to kill the virus. Some of the plants succumbed to the heat, but other survived. By indexing them, plants were found in which the virus was inactivated. These plants were then increased and eventually distributed to nurseries and growers, who are expected to keep them virus-free.

The viruses of fruit plants are mostly transmited from plant to plant by aphids. Leaf-hoppers and nematodes transmit others. With some plants the vector (the insect which transmits the virus) is unknown.

Virus-free plants must be protected from re-infection by viruses, or the efforts to clean them up will be wasted. The virus-free plants are protected by growing in screen houses so the vectors cannot reach them. Soil fumigation and the use of insecticides are additional precautions.

The propagations from screen-house stocks are increased outside, well isolated from other plants which might be a source of re-infection. Frequent spraying eliminates any vectors that might be present.

Virus-free plants of most strawberries and raspberries are now available and are much superior in vigor and fruitfulness to the older stocks. Several cherry and plum varieties have been de-virused and the viruses of grapes, apples and pears are being studied. Home gardeners should seek sources of virus-free plants and plant no others in their fruit gardens. —*G.L.S.*

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For a list of topics see back cover.**

John Horn

The Brooklyn Botanic Garden Conservatory, built in 1912. Each year 20,000 school children visit it through a special program sponsored by the Garden. Many school groups and individual students also visit the Conservatory apart from this program.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

One of the purposes of the Winter Issue of **PLANTS & GARDENS** upon its initiation 27 years ago was to make available to readers articles of unusual merit that had appeared in other periodicals in the previous year. Often these were articles of a semi-technical nature pointing up scientific work that was quietly going on behind the main horticultural scene, but which had implications for gardeners everywhere. With this digest issue, readers will notice again a slightly greater-than-usual attention upon works-in-progress by botanical researchers. Guest editor of the "science corner" this year is Dr. George S. Avery, Director-emeritus of the Botanic Garden and an early researcher in plant hormones.

Special attention should be given Georges Morel's article beginning on page 20. Although of a technical nature, it will repay the careful reader, for this French investigator has been in the forefront of exciting research in tissue culture. Special note: this coming autumn, in a revision of the Botanic Garden Handbook **BREEDING ORNAMENTAL PLANTS**, there will appear in translation from the French an article titled "Plants without Mothers" by Professor Morel's late colleague, Jean-Paul Nitsch. Dr. Nitsch was a pioneer in this related field—the growing of entire plants from mere pollen grains.

Let us take this opportunity to thank all of our authors, as well as the periodicals in which their articles first appeared, for permission to reprint their findings and observations. Only through such contributions as these has it been possible to bring together this 112th issue of **PLANTS & GARDENS**.

It will come as no news to Brooklyn Botanic Garden members—but it may to some of our P & G subscribers—that the hands of directorship at B.B.G. have changed in recent months. For a report on the new person at the helm, Elizabeth Scholtz, please turn to page 4. Her immediate predecessor, Louis B. Martin, will become president of the Chicago Horticultural Society in June, and good friends of the Botanic Garden will want to wish both of them well in their new positions.

Finally, some of our readers from other parts of the United States who have not visited the Botanic Garden may take very special interest in John Horn's photographic depiction of B.B.G. (see pages 2 and 31-34). The unspoiled verdure of the Botanic Garden, sometimes taken for granted by New Yorkers simply because it has continued uninterrupted for 62 years, is one of the Garden's most significant—if unsung—contributions to city life. One is reminded of the remark of environmentalist René Dubois: "The greatest crime committed in American cities (today) may not be murder, rape or robbery, but rather the constant exposure of children to noise, ugliness and garbage in the street, thereby conditioning them to accept public squalor as the normal state of affairs . . ." May the Brooklyn Botanic Garden, in its own way, continue to do all it can to mitigate this crime.

Frederick McGourty, Jr.

Editor

An Interview with Elizabeth Scholtz

On January 1, 1972 Elizabeth Scholtz assumed the responsibilities of leadership at the Brooklyn Botanic Garden. She is the fourth director in the 62-year history of the Garden, succeeding C. Stuart Gager, director 1910-1943, George S. Avery, 1944-1969, and Louis B. Martin, 1969-1971. Elizabeth Scholtz is also the first woman director of a major urban botanic garden in America.

Elizabeth Scholtz needs no introduction to many friends of the Garden, above all to students who have attended any of the popular-level short courses. As head of the adult instruction program for eleven years, she was instrumental in course enrollment growing from 1,100 in 1960 to over 4,000 in 1971. Largely due to her efforts in broadening the appeal of this important program, adult courses are thriving now more than ever before in the history of the Garden.

Elizabeth Scholtz has also been responsible for planning and leading the immensely successful Brooklyn Botanic Garden members' tours to various parts of the world, including Japan, Australia and South Africa. A native of the last country, she obtained her BS degree in botany and zoology at the University of Witwatersrand. She has a wide background both in the medical and botanical fields. Specials hobbies: American wildflowers and dye plants. She helped bring to fruition DYE PLANTS AND DYEING, *a Handbook that has had greater international appeal than any other of the fifty special-feature issues in the* PLANTS & GARDENS *series.*

In a recent interview, several questions were asked Miss Scholtz. The questions and her answers follow:

When did you come to the United States?

The first time was in 1957, when I received a fellowship to do research in haematology at Yamins Blood Laboratory, Beth Israel Hospital (Boston), which is associated with Harvard University. Previously I had been a blood technician at Groote Schuur Hospital in Capetown. Groote Schuur, literally "big barn," is best known to Americans through Dr. Christiaan Barnard, who performed the first transplant of the human heart there.

How did you come to the Brooklyn Botanic Garden?

I returned to South Africa in 1958 after the International Haematological Congress in Rome. Dr. Margaretha Mes, Professor of Botany at the University of Pretoria, who had collaborated on plant hormone research with Dr. Avery [Director of the Brooklyn Botanic Garden], had encouraged me to meet him upon visiting the U.S. I did, and I eventually joined the Garden staff and became responsible for the adult instruction program.

What was your first impression of the Botanic Garden?

I came in mid-summer, not the best time to see the Garden—nor, in fact, New York City, which is uncomfortable

Elizabeth Scholtz has been appointed director of the Brooklyn Botanic Garden.

Photo by courtesy of The Spectator, Hamilton

then, especially to people not accustomed to extreme variations in temperature. It stuck in my mind that the Garden was a cool green haven in the midst of the city's heat and bustle. I am sure countless other visitors have had the same impression I did.

Occasionally there have been suggestions that the Botanic Garden, because of the city's deteriorating financial and social conditions, should move to more pleasant surroundings in the suburbs. What do you think of this?

Not very much. There is a much greater need for the Garden in New York City, and particularly in Brooklyn. The Garden is *people*. In some years it has 1,500,000 visitors. Because of its central location, only fifteen minutes by subway from downtown Manhattan, it has a social, not to mention educational importance that is unmatched by any other botanic garden in the world. I cannot conceive of the city withdrawing its financial commitment to the Garden (a little under one-half of the Garden's current budget) and precipitating such a move. The Brooklyn Botanic Garden has too vital a role in the lives of too many people.

But what about vandalism?

There is a human tendency to exaggerate vandalism. It of course occurs in the Garden from time to time, but less so than in other parts of the City. Having walked through the Garden almost daily for more than eleven years without incident, I feel it is a safer place to be than, say, Fifth Avenue. This is not to say we do not need more guards. Perhaps the biggest deterrent to vandalism is the visitor who, because he regards the Garden as his own, does all he can to safeguard it.

—and air pollution?

The only particularly noticeable problem here has been with lilacs, and Dr. Craig Hibben of our research staff at Kitchawan is devoting considerable time to them in the hope of eventually finding resistant forms. The fact remains that 12,000 different kinds of plants, representing one of the largest botanical collections in the United States, are being grown at the Garden. Granted, the environmental conditions are not ideal, and we don't always grow plants as well as we would like to, but the social "return" from these plants is considerably greater than if they were faultless specimens in a garden little visited by the public. Actually, most of our plants grow satisfactorily, and when they don't, there is usually a cultural reason. I don't mean to minimize the real hazards of air pollution on city life, but merely to report what has been our own experience with plants at the Brooklyn Botanic Garden.

What courses have given you the most satisfaction?

That's the wrong question to ask. Better—what courses have given students the greatest satisfaction? Mostly it's the ones where people can get their fingers in the soil. "Learn-by-doing" in the instruction department greenhouses has been an integral part of both the children's and adult programs since the beginning of the Botanic Garden. It is no accident that a simple class on growing avocados and similar grocery-store fruits from seed is one of the most popular of all. People are starved for growing living plants in the city.

Did you notice this before the current rise in interest in ecology?

Yes, it seems almost a primeval urge. However, more young people are attending courses now that ever, and often their interest stems from a larger concern for the natural environment.

How else do they differ from older students?

There are more and more requests to hold courses on Saturdays and week nights. These are working people for the most part. They are extremely responsive, perceptive, and usually show a strong interest in the subject being taught.

What changes would you like to see in the instruction program?

One of the main ones is credit courses for high school seniors who are interested in plants. If we had more facilities and instructors to do an actual in-service program of this sort, this could be an important contribution. I am afraid it is not feasible at the moment in view of the city's financial condition.

What do you think of the ecology movement?

It's all very well to stand up on a soapbox and preach ecology and pollution control, but I think to have a direct contact with plants is the easiest way to learn about ecology. I don't see dirty fingernails on the ones who usually speak the loudest.

Budget crises with the city have occurred for several years. Where does this leave the Botanic Garden?

The Garden provides essential services to the people of New York through its instruction programs and plant collections. As the quality of our urban surroundings declines, it is ironic that the extent of the city's responsibility to us is in question. Frankly, it is the botanic gardens as well as our sister cultural institutions in New York that make urban life tolerable to many people. Never before, in fact, has the purpose of the Garden been as vital as it is now. In this situation the role of the private donor is going to be more important than ever. It is unreasonable to expect the private donor to assume responsibilities for services that have been traditionally those of the city, but if it were not for membership support and gifts, the Garden's very existence might be in jeopardy.

What is the role of Botanic Garden fellowships?

I think we must give more attention to them because they provide invaluable educational experiences for talented young people here at the Garden. Such fellowships are made possible only through gifts to the Garden, and support for them should be better understood. Over the years, the Garden has "hatched" the careers of many student-trainees who have gone on to become leaders in their profession. I hope the program will expand.

Would you advise a young person to go into horticulture today?

Of course, providing he—or she—is willing to work hard and to forgo great financial compensation. It may be different in other fields, but a student with a degree in horticulture cannot expect to start at the top, for there is much that can be learned only from practical experience. However, the rewards are of a personal nature, particularly for those who like people as well as they do plants, and won't ever be taken from you. ◆

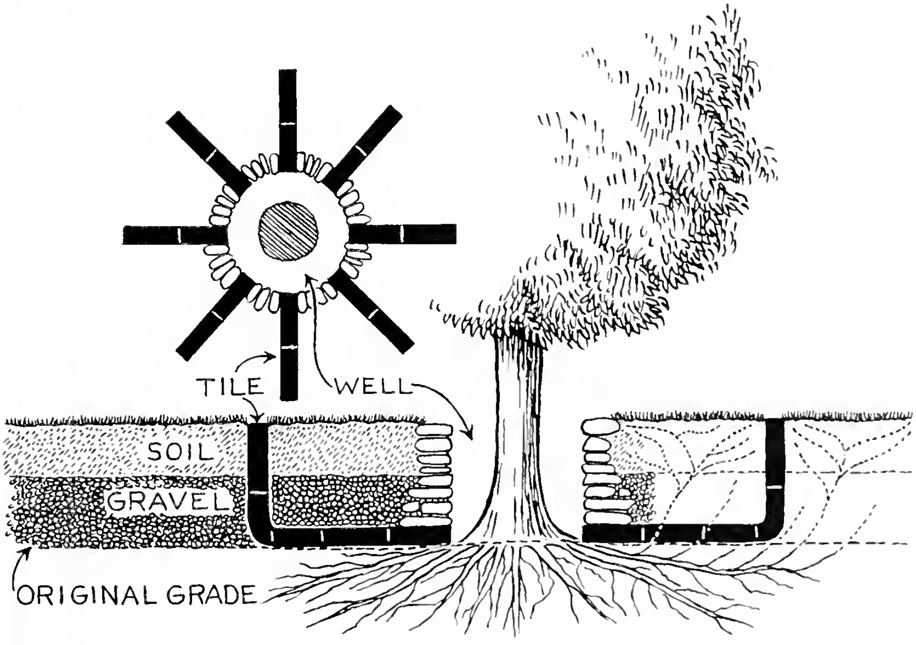
An "Air Conditioning" System for Trees

John Van Camp

From Arborist's News, Dec. 1970

IN the construction process on new house lots, there is often the need for grade changes. If the grade has to be lowered around a tree, it can be done in moderation, even with the oaks. The most common problems with grade changes, however, are those concerned with raising the grade around trees. The owner, the architect and the contractors will almost always consider a tree as a king-sized weed—ready, willing and able to tolerate all kinds of abuse. But, just 2 inches of heavy clay on top of the original grade can suffocate the roots of those tree species intolerant of poor soil aeration. It is not enough to simply build stone "wells" about the trunks of species whose roots require well aerated (porous) soil. A complete "air conditioning" system should be built over the root zone of the tree if the species, depth of fill and the value of the tree dictate and justify this expense. (See diagram below.)

This "air conditioning" system is constructed by establishing a layer of number 10 gravel over and around a system of ventilating tubes in the form of drain tile. These tiles should be laid on the original grade, where possible, and should be positioned to form a wagon-wheel shape around the tree with the hub-end of the spokes opening into the well that is built around the tree trunk. At the far end of the spokes, it is advantageous to place a tile in a vertical position to connect the grid system below with the atmosphere above and thereby provide a chimney effect for improving air circulation through the tile and the entire blanket of gravel. Some thought must be given to drainage of water in this tile system and to the possible threat of chipmunks taking up residence in this "housing and urban redevelopment" project!



Eva Melady

Warman

Bald-cypress *(Taxodium distichum)*, a tree commonly associated with swamps, thrives on a street in New York City.

Lowland Trees for City Streets

John Van Camp

From Arborist's News, Dec. 1970

LET'S begin with terminology used in the relationship between a tree and its environment. We find all too frequently the word "preference" used to describe this relationship. Even many of our textbooks and bulletins have been prone to say a walnut tree "prefers" a deep, well-drained soil—or that a bald-cypress tree "prefers" an abundance of water in its environment.

Actually, a tree does not have the capacity to "prefer" or "not prefer" a given soil condition. Rather, this relationship is expressed by the degree of the tree's *tolerance* or *intolerance* to a given soil condition. The bald-cypress tree *tolerates* the water covering its roots in the swamps; it does not necessarily "prefer" this condition, as evidenced by the fact the tree may not benefit by the overabundance of soil moisture.

Bald-cypress Tolerance

The bald-cypress, as well as our various other "swamp trees," lives very well on drier sites and in city and park plantings. This fine line drawn between "preferences" and "tolerance" is absolutely essential to the understanding of the tree-soil relationship if we are to recognize the varying degrees of *tolerance* to a soil condition expressed by the different tree species with which we work.

Our friends, the oaks, and other trees growing in natural woodlands and forests can, in some locations, approach optimum growing conditions. In contrast, the trees with which we work in urban areas very seldom enjoy optimum conditions for growth, and we are chiefly concerned with helping them stay alive by overcoming the many complex environmental deficiencies forced on them by city living.

The man who said, "A tree planted in the city starts to die the day it is planted," intended to exaggerate; but he expressed very well the struggle to exist facing many newly planted city and park trees. The success or failure of that tree depends to a large extent on its tolerance of the various conditions which have been forced upon it by its unnatural environment.

Some observations we have made during our work in various cities of the Middle West over the last 13 years lead us to theorize that, contrary to popular belief, our city trees suffer more from deficiencies in *soil aeration* than from deficiencies of soil moisture or soil nutrients. Our data have shown us that in the dry soils that are apt to be encountered in cities, the species of trees we normally associate with flood plains and bottomlands in their natural habitat, maintain faster growth rates and stay in better vigor and condition than upland tree species.

These observations suggest that in our fine- and medium-textured clay soils and with our average annual rainfall of the middle-western "corn belt," soil moisture is *not* usually the limiting factor in tree root development along city streets. Some studies of soil moisture content and tree root growth under city streets were made by working alongside trenching machines of city water and sewer crews. Fact finding became easy as they trenched in streets as well as along the planting strip between curb and sidewalk and bored under cross streets.

These studies were particularly revealing when the crews dug holes 6 feet deep in the middle of a concrete cross-street and tunneled in from both sides. Strange as it might seem, there was very little difference between the moisture content of the soil found under the concrete-slab in the middle of the 30-foot-wide streets and that at a comparable depth in the trench at the curb. Soil moisture moved by capillarity under the concrete from both sides of the street and was adequate for root growth. Yet, no trace of roots could be found in the excavations under the concrete. This in spite of the fact that elm trees stood at the curb 20 feet away and elm roots could be traced approximately 30 feet each way along the trench.

Since adequate moisture was available under the center of the city streets for tree root growth, our observations indicate that in our region, hard-surfaced city streets and sidewalks limit tree root development more by interfering with normal diffusion of soil air than by preventing the infiltration of soil moisture. The soil under streets is heavily compacted by weight of vehicles on the pavement above.

This limitation in soil aeration by streets and sidewalks possibly explains why tree species normally associated with flood plains and lowlands appear to show better survival, better growth rates, and better condition when planted along city streets and in parks than do the upland species. The bottomland species, such as sycamore, pin oak, elm, soft maple, poplar, swamp white oak, red maple, willow, river birch, box-elder and bald-cypress, while certainly not all recommended species for planting, all possess various degrees of tolerance to soil with low oxygen content. In the language of the biologist, roots of such species are relatively *anerobic*, which means that they get along well in the absence of free oxygen.

We regard the tolerance these trees exhibit as a fundamental tolerance to faulty soil aeration rather than a specific tolerance to excessive soil moisture. Therefore, to these and to other bottomland species, it makes little difference whether the faulty soil aeration is caused by a layer of water, a layer of concrete, or a layer of severely compacted soil. They can tolerate those conditions and continue to live when their upland 'cousins' such as the oaks: white, bur, red, black, and scarlet, along with hickory, sugar maple, ash, lindens, and tulip-trees would show their intolerance to poor soil aeration in symptoms of yellow leaves, small, stunted foliage, and gradual dieback in the crown over a period of years. ♦

Flowers on Avenue D

Charles A. Lewis

From Horticulture, August, 1971

FOR the past eight years the New York City Housing Authority, the world's largest landlord—with 600,000 tenants, has conducted a horticultural contest that has reaped a harvest, not only of flowers, but of human and social gain as well. What began as a beautification contest has become an adventure in the discovery of new values for living. Nine years ago Ira Robbins, then Vice-Chairman of the Authority, was looking for a way to beautify its 171 housing projects. Mr. Robbins adapted a plan used in Chicago where maintenance divisions competed with each other in growing flower beds at their projects. The New York Authority decided, instead, to allow groups of tenants to grow the flower beds and compete with groups from other projects.

A notice to this effect went out in March, 1963. One hundred and five entries were received representing 65 projects and over 1,000 tenants. By 1969 it had grown to 327 gardens, involving 4,800 tenants.

Any group may enter by filing an application in March with the project manager. A full gamut of associations is represented, including children's day care centers, Boy Scouts, ethnic societies, senior citizens' clubs, handicapped workers and youth groups. The Authority provides locations for the beds not exceeding 300 square feet, and fund of $25 per garden is allowed for the purchase of seeds, plants, fertilizer, etc. It also lends tools and hoses and provides storage for equipment as well as guidance in the form of an instruction manual. Meetings are held, some sponsored by the Horticultural Society of New York, to teach the basics of gardening. Maintenance staffs may assist in soil preparation only. All other work must be done by the contestants.

Each group develops its own design and decides upon the plants to be used: usually annuals, summer bulbs and, occasionally, vegetables tucked into inconspicuous spots. Some beds are simple, others complex, even pictorial. Some contestants grow their own plants, starting seeds on window sills, while others purchase seedlings. During the summer each group tends to its own watering, weeding and fertilizing.

In early August the gardens are reviewed by a horticulturist to eliminate plots not worth judging due to neglect or other reasons. Then a team of three judges is selected for each of the five boroughs of the city. The judges, including horticulturists, garden editors and writers, educators and landscape architects, use a point system developed for this competition. First, second and third places and special mentions are chosen for each borough. The awards, silver trays, are given at an impressive ceremony to which all of the participating groups are invited. Usually the mayor or his representative is present at this ceremony.

At first glance the garden competition sounds like a "nice" kind of event. But, let us look beyond the obvious benefits. As a judge, one of the first things I learned was the intensely personal feeling each participant develops toward his group's creation. At a pleasant garden in Lower Manhattan, a Spanish-speaking woman said proudly, "They told me you couldn't grow flowers on Avenue D, but I wanted to try. Now you should see how the old folks come out every day to sit and enjoy the flowers."

In Spanish Harlem where vandalism is high, the neighborhood patrolman was amazed that flower beds could exist without being destroyed. When asked how the miracle was accomplished, one resource-

Margaret Perry

The New York City Housing Authority has conducted an annual gardening contest that has reaped a harvest of flowers. Of greater importance have been the social and human gains.

ful group explained it knew who the troublemakers were and assigned them the job of guarding the plantings.

After several years the Housing Authority discovered additional benefits. There was a decrease in vandalism of trees and shrubs planted by the Authority. More surprisingly, vandalism inside the buildings was also reduced. Tenants even became interested in decorating their lobbies. They asked to be allowed to participate in landscaping the buildings—the antithesis of vandalism.

It is obvious that various forms of gardening by residents of disadvantaged areas exert a positive effect far beyond the presence of the plantings themselves. People discover in their gardens a depth of experience and values not readily found in their surroundings.

The beauty of flowers appeals to a person's nobler instincts and the stark contrast of a disadvantaged neighborhood presents the greatest potential for exerting this appeal. The gardener bears sole responsibility for the life of his plants. It requires a certain amount of knowledge and skill to bring them to flower but they blossom predictably, if given proper care.

Growing plants is also an activity that opens lines of communication across barriers of age, language, race or social position for flowers are nondiscriminating. They bestow their beauty upon all without judgment, criticism, mockery or complaint. They provide an avenue for self-realization and self-esteem—sorely lacking in their lives.

Walter Hickel called for a "personal kind of ecology—call it ecology of the mind and spirit of man. There is a mystery attached to the variety and perfection of nature, a mystery which stirs wonder in a child and gives a grown man perspective. If we help refresh the inner man, we begin to answer such real problems as those of the inner city." In the ecology of the human spirit the microclimate of a flower box or flower bed contains a tremendous healing force. ◆

House Plants for Office Decoration

Charles Marden Fitch

From New York Botanical Garden JOURNAL, Feb. 1971

MANY business offices seem to cry out for the touch of life that plants can bring. Office workers seek plants that can survive in an office atmosphere, provide a touch of the personal in an impersonal setting, and enhance the working surroundings.

If you enjoy personally growing a few unusual yet basically adaptable plants for office decoration, these suggestions should be of special interest.

First of all, consider the basic requirements for growing any indoor plant, and how these may be approximated in the average office. Every plant needs an environment suitable for its species. Three major factors are important for all plants:

Correct Lighting Intensity

Supplement low light with fluorescent fixtures. Horticultural plant growth lamps, Gro-Lux, or Natur-Escent, are the most efficient. Even incandescent spots are better than no supplemental light.

Sufficient Humidity

Use trays filled with moist gravel or perlite to maintain minimum 40 percent humidity for all but succulents.

Proper Temperature

Over this factor you can seldom exercise much control. Therefore select plants that do best with a 60° to 70° minimum night temperature.

Once a proper environment for plants has been created, help the plants along by intelligent application of good cultural practices.

1. Use correctly formulated potting mixtures in containers with good drainage.
2. Supply water to roots only when necessary.
3. Prune constructively to control plant shape and size.
4. Use only light dilute applications of fertilizer in keeping with the plant's activity and species.
5. Wash or shower monthly all plants that must endure atmospheric pollution. Accumulations of solid soot and dust are especially harmful to plants.

Choosing Plants

Everyone who loves plants seeks the ultimate gem, a constantly flowering and adaptable plant that looks attractive twelve months of the year, with hardly a bit of loving care. In my own search for plants that approach this ideal, I have compiled a list of satisfactory tropical plants for indoor decoration, and some of the more adaptable of these are suitable for offices. They are listed below in accordance with the setting to which they are best suited.

Dry, Hot, Sunny Windows

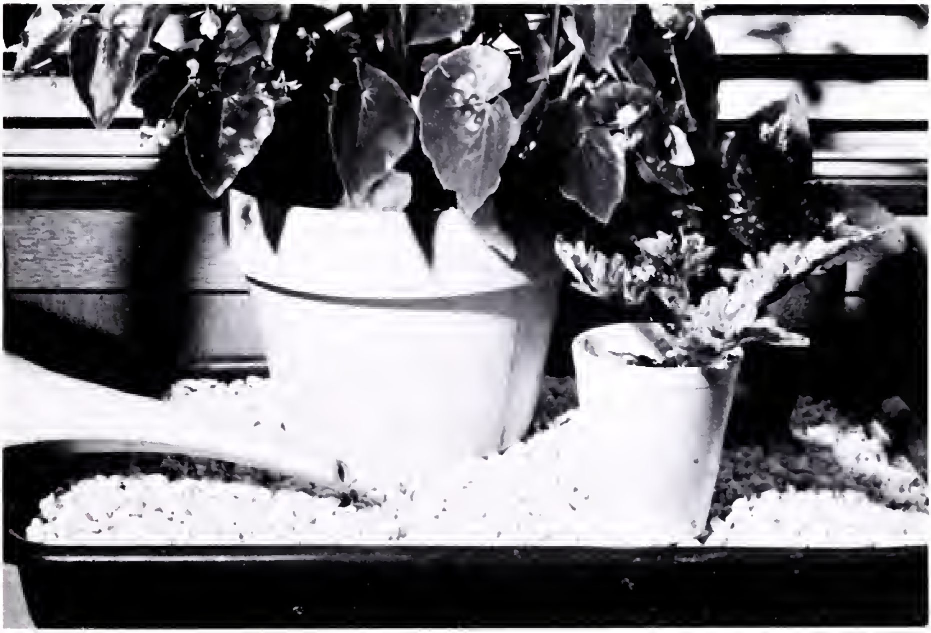
Euphorbia × keysii: This lovely hybrid was produced by crossing two Madagascan species, *E. lophogona* and *E. splendens*. It constantly produces coral-to-red flowers from the terminal of each spiny few-leaved stem. It does well in a standard house-plant soil mixed 50-50 by volume with a planter mix, potted in a well-crocked container, and permitted to almost dry out between waterings—especially when it is not under ideal growing conditions. This hybrid *Euphorbia* is superior in both growth habit and floriferousness to the more commonly grown *Euphorbia splendens* (crown-of-thorns), known to some botanists as *E. milii.*

Stapelia gigantea: From dry regions of southern Africa comes this non-spiny succulent with four-sided, tower-shaped stems. The spectacular 8-to-10-inch flowers are usually produced when the plant is pot-bound and grown under bright

Right: A sunny office window is an ideal situation for *Euphorbia x keysii,* an improved hybrid of crown-of-thorns.

Below: An increase in humidity around indoor plants, especially when they grow in dry offices, is achieved by standing plants on top of a layer of moist perlite or gravel. Select a deep tray and maintain the water level just below the top of perlite or gravel. Water which evaporates from the tray slows the drying of the potted plants by increasing atmospheric humidity.

All photographs by Charles Marden Fitch



light. Under most office conditions, the plant may not flower, but as an attractive succulent it is still worth growing. (The flowers, unfortunately, smell rather like spoiled meat if you stick your nose close to them, but the olfactorily hypersensitive can always bud pinch).

Early Morning or Late Afternoon Sun

Aechmea fasciata varieties: This vase-shaped 10-to-12-inch tall epiphytic bromeliad from tropical Brazil is an adaptable subject, which produces a showy inflorescence of red or blue flowers among pink bracts. The plant should be grown in osmunda fiber, or in a very porous mixture of tree fern and sand, over an inch or more of crock. Water poured into the rosette or cup keeps the plant moist and helps it to endure low humidity. *Aechmea fasciata* is sold by many florists when it is in full bloom. The inflorescence will last for a month or more, even under conditions of low light and poor humidity. After blooming, the main plant rosette dies a slow operatic death, sprouting a number of basal off-shoots as its final heroic aria. If these propagations are cared for, you will soon have a new production ready for applause.

Billbergia zebrina: White, green, and bluish scales over the stiff, cylindrically arranged leaves are the attractive feature of this bromeliad. An easy grower, it has a rocket-shaped, salmon-pink inflorescence that produces numerous flowers, which often self-pollinate to create interesting fruit. Grow billbergias with the same culture outlined for *Aechmea*.

Bright but Diffuse Light

Saintpaulia African-violets: These small, attractive plants are easier to grow than many home gardeners believe. The plants, in blue, purple, pinks, white, and bi-colors, are readily found at florists and supermarkets. Try growing African-violets in self-watering wick pots with a medium of Black Magic. An African-violet plant in full bloom, with one of the new circular fluorescent plant-growth lamps is an imaginative gift for an office friend.

Coleus blumei strains and clones: These delightful multi-colored foliage plants will produce spires of blue flowers under ideal conditions. The accommodating plants also furnish easily rooted cuttings for any visitor who admires your office clone.

Begonia rex: Florists can supply nicely grown plants of many Rex begonias. Keep these bright-leaved plants on humidity trays of moist perlite or gravel to enjoy them in perfection for a month or more. 'Merry Christmas' is one of the brighter, adaptable Rex begonia clones.

Hoya carnosa variegata or *Hoya carnosa* 'Exotica', the wax plant: Both of these slow-growing, waxy-leaved vines, originally from Australia, will do well trained over a window, around the base of a desk lamp, or along a valance under a large (40 watts or more) fluorescent lamp. Hoya should have a well-drained medium. I use a planter mix with sharp drainage of broken crock and extra chunks of charcoal. The container should be on the small side to let the roots fill it in several months. This will help to prevent damage from over watering, and encourage flowering.

To water Hoya, soak the medium and then let it almost dry completely before watering again, especially when the plant is not in active growth, usually during the winter months. It is a good idea to shower the leaves in a sink every few weeks. The fragrant, heavy-substanced flowers are produced in pendant umbels from the tips of spurs that continue to bloom year after year—so do not prune off these short spurs!

Trailers and Runners

Chlorophytum capense variegatum (*C. elatum*), the trailing *Zebrina pendula* varieties, and the various forms of Tradescantia are all good plants to grow on a shelf or at a height so that their stems can cascade downward. *Chlorophytum*, the spider plant, is said to be common, yet a number of my friends have expressed delight at seeing my specimen, and were subsequently happy to receive some of the abundantly produced

Various foliage plants inhabit a large circular container in the Banque National of Paris. Plants include ferns, palm, monstera and hydrangea for seasonal color.

runner plants. These trailing subjects will grow for a long while in water.

Another wandering plant that is very sturdy is *Setercasea purpurea.* But its deep purple color and lavender-pink flowers are common only under bright light. This is one plant that does well in a dry, hot, sunny window as well as under the cooler, less bright light that is more often found in modern office buildings.

Survival Tips for Office Plants

Although the plants discussed here are quite adaptable, all of them will benefit by a temporary transfer to ideal growing conditions every few months. The actual length of time a given plant will look attractive under somewhat hostile environmental conditions depends upon the genus and the species. A coleus, for example, may hold bright colors and attractive shape in low light locations for two weeks. In contrast, a blooming *Aechmea fasciata* should remain appealing for upwards of six to eight weeks under similar conditions.

With plants that require high humidity, above 50 percent, keep a compact plastic spray bottle in your desk, and use to give the plants a daily morning misting of water.

Do not over-fertilize or over-water.

Arrange the plants for survival before you go on a long vacation. The following three good ideas may be of assistance here:

1. Put the plants under an automatically timed fluorescent fixture holding two or more plant-growth tubes. Set the pots on a tray of moist gravel or perlite.

2. Take the plants home from the office. Let them vacation under better cultural conditions than you may be able to provide in your office. For instance, you may have higher humidity and brighter light, or perhaps you might be lucky enough to have a greenhouse.

3. Give your office plants away to someone who loves growing them. You will have fun selecting new treasures after your vacation is over. ◆

Bottle Gardening

THE U. S. Dept. of Agriculture suggests that bottle gardening may be the answer for those who hesitate to grow plants indoors because of lack of soil. It is also a solution to drip and water markings on furnishings. Start a bottle garden with a collection of containers, such as shown at left.

Above: First wash containers with soap and warm water; rinse. Then select cut stems of plants such as periwinkle *(Vinca),* ivy, geranium, oleander, willow, philodendron. *Below:* Cut the stem the length most suitable for container; remove all the leaves below water line.

Below: Arrange the branches to create a natural effect. Final bottle garden is shown above. Little care is needed, but water will evaporate and must be replaced. About once a month, empty bottles and clean to remove algae and molds.

Grafted Cacti from Japan

Frank Bowman

HIBOTAN, Red Cap, and Oriental Moon Cactus, are just a few of the names given to certain colorful kinds of grafted cacti that are being imported from Japan in large quantities. Thousands of nurseries, florist shops and even chain stores are now selling these house plant novelties in the United States. Such plants have in fact become one of the hottest items in the trade in the last several years.

The colorful tops (scions), available in shades of red to pink, pink to white, and yellow to orange, are variants of *Gymnocalycium friedrichii,* a cactus native to South America. They do not have sufficient chlorophyll to live on their own roots, and the common propagation method in Japan is to graft them when they are seedlings—about the size of a rice grain—onto a vigorous chlorophyll-bearing understock, usually *Hylocereus guatemalensis.* Besides enabling the top to live, this understock, which is green, provides a pleasing and distinctive contrast that makes the color of the top more vibrant.

The Brooklyn Botanic Garden periodically receives laments from apartment dwellers that these grafted cacti are short-lived. Information on how to care for the plants is often not given the purchaser, or when it is, it is usually vague. However, if you understand the cultural requirements of these new introductions from Japan, the plants will add a bit of extra pleasure to your indoor garden.

Bear in mind, above all, that they belong to the cactus family. When you think cacti, think sun! Put the plants in the sunniest spot in your home. This is especially important with the grafted ones, for it will bring out their rich colors. They don't need much space, since their usual height is only 4 or 5 inches.

The soil should be an ordinary potting soil made porous by the addition of gritty sand, perlite or aquarium gravel. It should be well drained, since cacti cannot tolerate "wet feet." Do not hesitate to incorporate as much as one-third dried cow manure in the potting mixture. Cacti thrive in it. In early spring and again in mid-summer, fertilize with any house plant food.

Watering: soil should be kept moist but not wet, since the cactus used for understock, *Hylocereus guatemalenis,* grows under natural conditions not in desert soil but the forests of Central America. If in doubt, allow to dry between waterings.

In time, offsets may form from the base (the *Hylocereus* part) of the grafted plant. Cut off and discard them so they won't compete with the top. If offsets form on the top (the *Gymnocalycium* part), forget about rooting them, for they can survive only by grafting. One final point: flowers are known to occur from time to time, but they are not normally produced. Best enjoy these grafted cacti from Japan for their novelty alone. ◆

Offsets on top of this grafted cactus can only be propagated by grafting.

Photographs by George Kalmbacher

A recent novelty among house plants is the Japanese grafted cactus.

Plant Tissue Culture—and Plant Breeding

Georges Morel

Editor's Introduction: *Discovering how to grow undifferentiated plant tissue in artificial culture is one of the significant advances in botanical science of our time. "Undifferentiated" simply means that all the cells in a tissue are simple in structure and are alike. When a part of a living plant, most cells become specialized in structure and take on special functions. However, some cells normally remain undifferentiated, such as the pith and cortex of stems (parenchyma). If a plant tumor develops, its cells remain undifferentiated. Or, if a plant is wounded or cut in some way, the tissue that naturally heals the wound (forms over the cut surface) is composed of undifferentiated cells. Small pieces of this may be excised and grown aseptically in culture on a suitable nutrient medium. Such a tissue is known as "callus." A few of the recent research advances that its culture has led to are discussed below.*

UNDIFFERENTIATED callus tissue taken from tobacco plants and grown in "test tube" culture for two years (Melchers and Sacristan) produced entire new plants. These were different from the variety 'Samsun' from which the callus originally came. For example, the form of the leaves was different and a high percentage of the plants did not produce viable seeds, i.e., they were largely sterile.

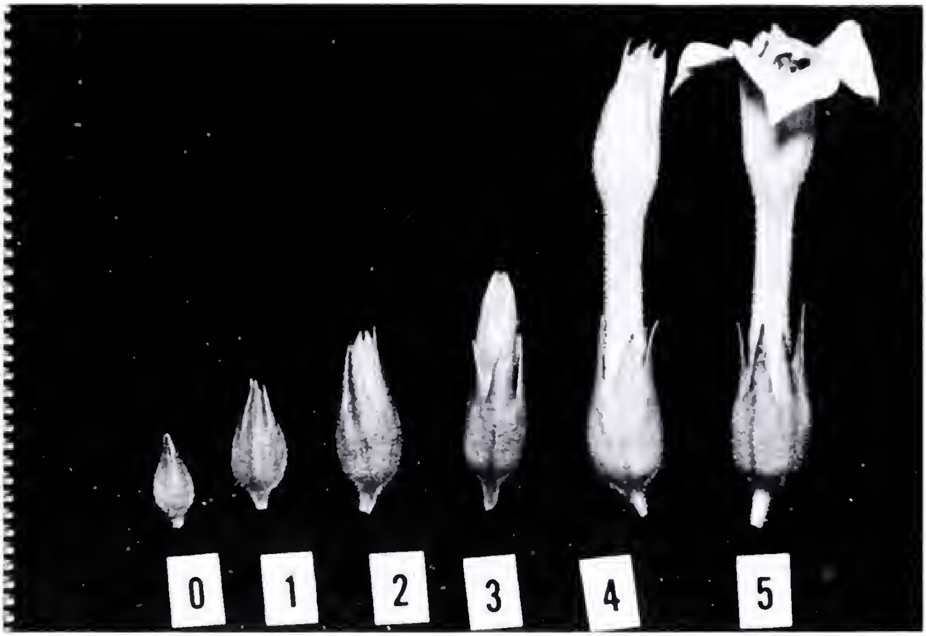
After nine years in culture, the callus was still able to regenerate new tobacco plants, but *all* the plants were different from each other and most of them were abnormal. All were sterile.

After more than twenty years in culture the callus tissue continued to be capable of giving rise to new tobacco plants, but the abnormalities were much more numerous than in previous years and showed hardly any characteristics by which they could be recognized as the variety 'White Burley' from which the cultured callus originally came. The normal chromosome number in tobacco is 48, but in the abnormal plants the number varied from 57 to 81.

Other scientific investigators have made similar or related discoveries, and such findings are by no means limited to tobacco. For example, at the Hawaiian Sugar Planters' Association Experimental Station, tissue culture constitutes an important part of the plant breeding program. In one instance it was noted that of 90 young sugar cane plants that grew from the same cultured tissue, 38 were visibly different. These are now being tested for their physiological and biochemical characteristics, and who knows, one of them may give rise to a superior new race of sugar cane!

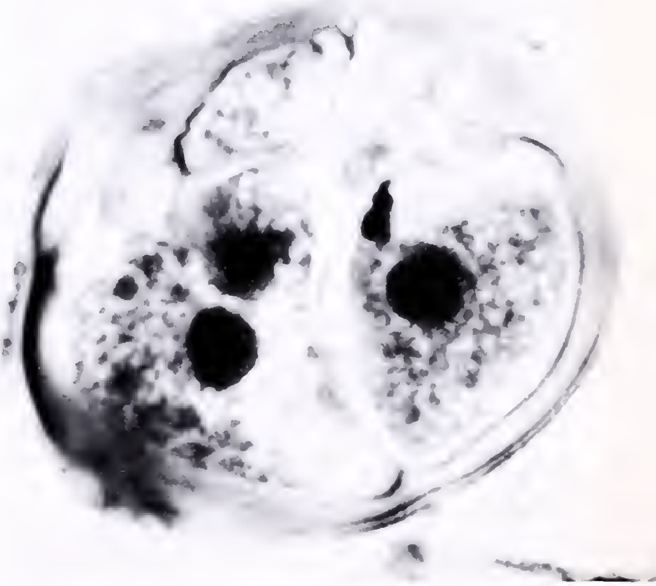
Genetically Pure Plants

Most cultivated plants do not breed true to type, which is to say that if the next generation of plants is produced from seed of some desirable "mother" plant, it is highly unlikely that the offspring will "come true." Few or none of the new plants will have the desirable characteristics of the mother plant from which the seed came. It ordinarily takes years of inbreeding to produce a pure genetic line. One technique for getting a genetically pure variety is to search for (or experimentally produce) haploid plants. This means plants with half the normal (n) number of chromosomes. Such plants are genetically pure, and when their chromosome number is doubled to make normal diploids (2n) by experimental techniques, the chromosomes



Flowers from normal tobacco plant—from tight bud stage to open flower. Stamens were asceptically removed at stage 3 and transferred to test-tube culture.

Pollen grain of tobacco (under microscope) after the first cell division. The pollen sac (anther) of a single tobacco stamen contains about 40,000 such cells. Normally, a sperm cell forms in each pollen grain and these are destined to fertilize the egg cells in the ovary of the flower. However, when the anthers are transferred to test-tube culture, a few pollen grains "give birth" to small masses of cells. Eventually the wall of such pollen grains break open and the small cellular masses develop into embryos.



Left: Typical tobacco embryos produced by pollen grains (while still within their anthers in test-tube culture).

Left: Tiny haploid plantlets emerging from embryos which are still contained within the anthers. Note the single normal stamen lying on the agar jelly culture medium.

are duplicates of those in the haploid. Thus the seeds produced by such 2n plants are genetically the same as the parent from which they came, and the plants they produce will be like the parent, *i.e.*, they "come true."

New Techniques for Producing Haploids

A new means of producing haploid plants was discovered by two Indian botanists in 1964 (Guha and Maheswari). They reported culturing the pollen sacs from stamens of a *Datura* species and noticed that a callus tissue developed from which new plantlets grew. In 1966 they described the phenomenon further, having discovered that perfectly normal embryos had formed from the pollen grains! It was from these "male embryos" that the new plantlets arose. Moreover, the plantlets were haploid, just as were the pollen grains from which they arose. This was the first discovery that embryos, normally associated with seed production in the ovary—the female portion of the flower—had ever been observed to develop from the male element of the flower.

Following this striking discovery many plant physiologists, mostly in France, Japan and Britain, have tried to extend and better understand this early discovery. In 1967 and 1968, Nitsch and his associates found that some of the species of the genus *Nicotiana* (tobacco) gave promising experimental results. Jimson weed, potato, tomato, petunia and tobacco are all members of the Nightshade Family of plants (Solanaceae). They took young immature pollen sacs (anthers) from inside the buds of tobacco flowers just at the time the young tubular flower (corolla) was bursting out of its sheath (calyx). Three to four weeks after planting the pollen sacs on a suitable culture medium, embryos—and later—plantlets emerged. The composition of the culture medium was not critical, and embryos would grow on a simple solution of sugar and tap water. Only a small proportion of the embryos developed into plantlets. In the case of tobacco, the pollen sacs (anthers) contain about 40,000 pollen grains, but the maximum number of embryos that develop from each anther is rarely over 100. Moreover, a pollen grain can develop into an embryo only when inside the anther. Pollen grains removed from an anther and grown on the same culture medium were never observed to form embryos.

Abnormal tobacco plant coming from a callus after 25 years in culture. (See also photo and description on page 24).

Pelletier (personal communication) made the interesting discovery that tobacco pollen produces embryos when transferred into petunia anthers growing in culture, whereas petunia pollen does not develop embryos when transferred into tobacco anthers.

In any case, the plants derived by this male-embryo technique are haploids, and herein lie important advantages in plant breeding, specifically as related to producing genetically pure strains of plants. Considerable basic research remains to be done before the technique becomes widely applicable.

(Continued)

Left: If callus tissue is grown in culture over too long a period of time, genetic deterioration sets in as shown in this potted plant in culture 20 years. The plant shows no resemblance to the plant from which the tissue was originally taken. The genes that regulate normal growth and development either lose their control or may be lost entirely, presumably because of environmental changes in the culture. Result: abnormalities appear in the plants that arise from cells in the aging callus cultures; ultimately no two plants from an aged callus are alike, even though the cells were all of the same genetic constitution.

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It is great loss for science that Dr. Jean-Paul Nitsch, well-known French scientist and in the forefront of this important new area of plant research, lost his life in a scuba diving accident in France this past summer. He was born and educated in France, worked wth me at Harvard for a time, and was a Cornell University professor for some years. He had for many years been Director of the LABORATOIRE DE PHYSIOLOGIE PLURICELLULAIRE at Gif-sur-Yvette, France. Not long before his death he wrote an interesting and thought-provoking review under the title *Plants without Mothers* (cited above). It is a technical presentation of his own work and that of his associates and others, and goes much further than this brief digest can even suggest.—G.M.

Gathering Herbs from the title-page of the GRETE HERBALL, London, Peter Treveris, 1526

In Praise of Herbals

Elizabeth Remsen Van Brunt

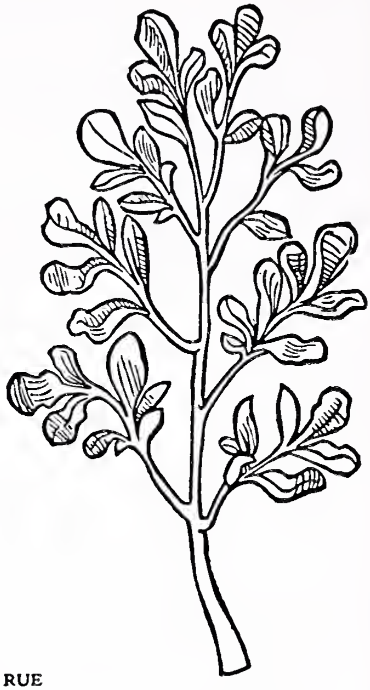
From The Herbarist, 1971

PROBABLY the earliest herbal known to man is comprised of stone tablets; examples are in the Metropolitan Museum in New York City, dating from 3,000 B.C. These ancient Sumerian archives delineate, cut in the stone, crudely, but recognizable, chamomile, thyme, roses and violets and elder. The Chinese and the Egyptians of that same period recorded medicinal uses of plants—*Ephedra,* for one—did we fatuously believe our present-day scientists had discovered the value of ephedrine? I am no student of mankind's history, but the fact that these earliest existing records are all of the period 3000 B.C. seems to place the date of the Great Flood just before that approximate date. The Greek philosopher wrote of herbs in the third century before Christ, and Dioscorides, the personal physician to Antony and Cleopatra, whose writings were a textbook for years to come, is still an authority. A recent reprint is available, in English.

Eleanour Sinclair Rohde felt that the *Grete Herbal,* a translation of the French *Le Grand Herbier,* printed in London in 1526 by Peter Treveris, was the first herbal ever printed in English. I cannot resist an anecdote: at a meeting of supposedly knowledgeable herb gardeners, someone spoke of *'Grete Herbal'* with awe and apparent authority, as one of the first of the group of herbals of the Middle Ages! A reprint of Richard Banckes' herbal was sponsored by the New York

Botanical Garden in 1941, and advertised as the first printed in English. Whichever of the two can rightfully claim that distinction, they were not printed more than a few months apart. Other popular reprints have been Thomas Tusser's readable (and rhymed) *Five Hundred Points of Good Husbandry* ('worn threadbare by the thumbs of men'), John Evelyn's *Acetaria* which the Brooklyn Botanic Garden had reprinted in 1937, Thomas Hill, Nicholas Monardes, Nicholas Culpeper and John Gerard. The last named is sometimes characterized leniently and appreciatively, as rogue—as was also Culpeper, for both made rather exaggerated statements. They were both popular, apparently digging out many facts for themselves even though arrant copyists, relying for the bulk of their descriptions and data, as well as illustrations, on earlier writers. However, we know that most of our books on herbs, today, proudly follow the same practice. And I will stand up for both Culpeper and Gerard, since having the common touch in their writing they are eminently readable as well as popular. An audience loves a speaker, a demonstrator who makes an occasional slip of the tongue—or of a carving knife!

John Gerard's *General History of Plants* has been reprinted in many editions. However much he quoted, with chapter and verse, he often engagingly let us know he was a true dirt gardener, with references to his own garden, with seed, with plants sometimes gathered from afar or given to him. He traced the course of their growth and cultivation, soundly and with helpful detail. He wryly commented on the use of rose hips (of the eglantine or sweetbrier rose, now proven to have enormous vitamin A content); "the fruit," he wrote, "when it is ripe, maketh most pleasant meats and banqueting dishes, as tarts and such-like, the making of which I commit to the cunning cook, and teeth to eat them in the rich man's mouth." Any herb gardener reading his quote from Clusius on the subject of rue would surely approach that herb with respect. I wish I had read that passage before my case of poisoning one hot week in July, from seeding rue! Clusius recorded: "a historie of a Dutch student . . . that went with him a-simpling, who putting some of it [rue] between his hat and his head to keep him the cooler, had by that means all his face presently inflamed and blistered wheresoever the sweate ranne down." It was found wise to eliminate rue entirely from the Children's Gardens at the Brooklyn Botanic Garden, for although the poisoning (which resembles ivy poisoning, with pain rather than itching) is seasonal, chances with groups of children could not be taken. *Editor's Note*: For more on poisonous plants, see page 55.



RUE

Gerard was tireless in tracing down plants and observing their virtues—and their faults, as well as botanical characteristics. He gives the impression, from his relating of the many qualities of plants, and experiences with them, of a courageous man—one who would "take on Hell with a bucket of water." For he often relates experiences, offering to help in an accident, effecting miraculous cures in poisonings, wounds and plagues. He recorded that the 'potato of Virginia' was a meat for pleasure, rolled in the embers and eaten with oil and vinegar and pepper, then quoted Bauhine: "that he heard the use of those roots was forbidden in Bourgondy for . . . the frequent use of them caused the leprosie." As for Jerusalem-artichokes: "In An 1617 I received two small roots thereof from Mr. Tranquevill of London, no bigger than hens' eggs, the one I planted and the other I gave to a friend; myn brought me a peck of roots wherewith I stored Hampshire." And of the common mallow: obviously indefatigable in tracing its places of growth: "it groweth very plentifully in the marshes both on the Kentish and Essex shore along the river, as Thames about Woolwich, Erith, Greenhyth, Gravesend, Tilbury, Lee, Colchester, Harwich and in most salt marshes about London: being planted in gardens it prospereth well and continueth long." He did get around—by horse or by foot, he saith not.

So, the British herbalists flourished in the 15th and 16th centuries. Then a gap, presently followed by a spate of doctors and medical students, also botanists. There were several women botanists who drew and painted plants exquisitely—Maria Sybilla Merion, Elizabeth Blackwell, and in 1846 Jane Louden.

A thoroughly scientific herbal was published in Philadelphia in 1848. Its author, Charles Frederick Millspaugh, a graduate of the N. Y. Homeopathic Medical College, practiced medicine for ten years before giving up active practice for devotion to botany and its application to medicine and economics. He taught Botany at the University of West Virginia and thereafter was curator of Botany at the Field Museum of Natural History in Chicago, taught at the University of Chicago and Homeopathic Medical College. A study of his *American Medicinal Plants* affords an insight into the interest and enthusiasm which his exhibits, combined with his teaching, received. His passion for accuracy is notable—descriptive botanical details as well as his beautiful illustrations include each plant's history, habitat, parts used and their preparation for medicinal use, plus the chemical contents and physiological action which are comparable to the Virtues listed as such in the old herbals. In the case of Hops (*Humulus lupulus*), he states that large doses of the oil may have dangerously serious results, although in minute quantities there is a useful sedative effect, 'probably not narcotic.' There is also an extensive Bibliography of his sources of research. This just-yesterday's herbal is a clue to the great herbals of the past, and interest in it, a guide to our reading of those. We may realize that even with our up-to-the-minute access to scientific research, our super-computerized methods, we may lose sight of the human element. To turn to the past for such contact is a most rewarding experience. When we use a modern paper tea-bag, for example, labelled 'Peppermint Tea' we expect it to contain the leaves of *Mentha piperita*, having absorbed into its growth the minerals of the soil in which it grew, the action of the air, the sun, the rain, the mists of early morning, the moonlight and starlight—until our eye is caught by the fine print—'artificial flavor'— as the envelope is plunged into the boiling water. Has our science progressed?

So sharpen your appetitie with samples of those early herbalists, but go to the originals (never be satisfied with digests)—and be inspired to raise, to use, to appreciate herbs by those clear voices of the past. F. Dawtrey Drewitt in his *History and Romance of the Apothecaries' Garden, Chelsea*, observed with truth: "Each generation must inherit imperfect truths from earlier generations. These well-worn clothes it seems sometimes better to mend and use, than hurriedly to throw aside—we may feel chilly without them." ◆

A possible future substitute for spraying?

Insect Sex Attractants

From New York's FOOD AND LIFE SCIENCES, October-December 1971

W. L. Roelofs

THE DEMAND for food to feed an increasing world population, combined with rising environmental concerns, has intensified the importance of the struggle between man and insects. Since insect competitors obviously are not going to be dissuaded from devouring our food crops, we must either lower our goals on food quality and quantity or find better ways of coping with these pests. One such control principle now being investigated employs sex attractants.

The attractants used by insects to locate their mates are among the most potent physiologically active chemicals known today. It would be very difficult for a lonely female lost beneath the cover of a single leaf to find a male located in the next orchard, or even the next tree, if it were not for the chemical released from the tip of her abdomen. A male of the same species can detect the chemical (referrred to as a sex attractant or pheromone) and fly directly to the female for mating. For example, it has been shown that male cecropia moths can be attracted over a distance of three miles in less than one hour to caged females.

One can easily envision the potential that sex attractants, which can be detected in minute quantities and are quite specific, have if used for insect control. Actual identification of these chemicals and their use in the field has been confined so far to a few species. However, techniques are now available for the rapid identification of many chemical attractants.

The Experimental Technique

An antenna is clipped from a male moth's head and attached to electrodes, which send the antennal responses to an oscilloscope for display. Air is continuously blown across the antenna and various test chemicals puffed into the airstream. When a test chemical brings about an antennal response, the change in antennal polarization is detected by the electrode and give information on the type of chemical emitted by female moths to attract males for mating purposes.

Trapping

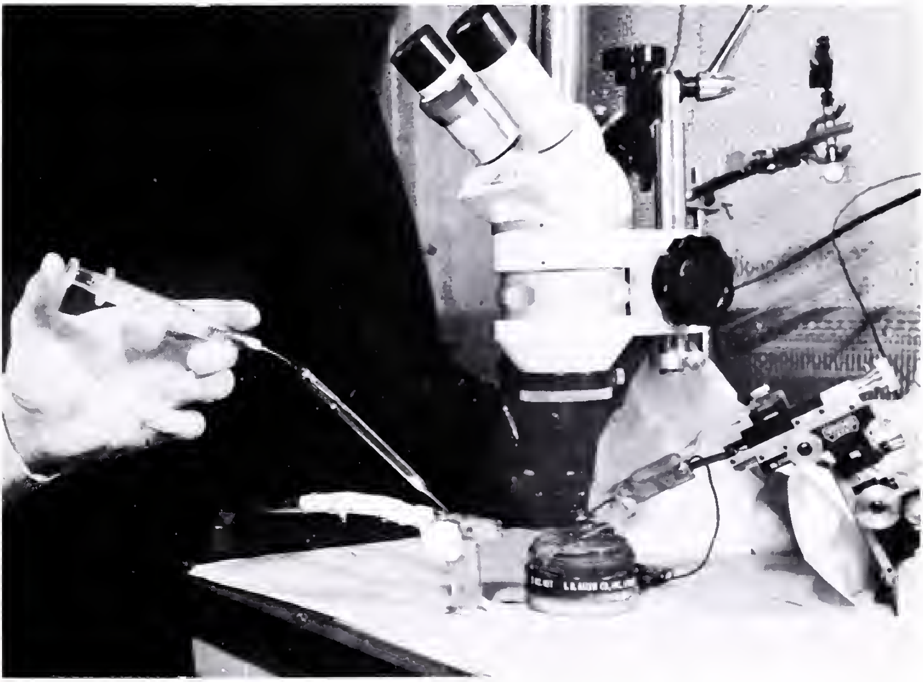
As new attractant chemicals are identified, they are used in conjunction with closely related chemicals in field screening programs. These various compounds are placed singly in traps throughout the countryside for the entire summer; insect species that respond to one of these compounds as their sex attractant are caught during their flight period.

The new technique employed in this research has aided in the discovery of sex attractants for more than 90 different species of Lepidoptera (an order of insects that includes the butterflies and moths), including such apple pests as the codling moth, red-banded leaf roller, oblique-banded leaf roller and oriental fruit moth. The attractants for these insects are now being tested in orchards in New York State, either to achieve outright control by mass trapping, or to monitor their presence and abundance.

Since many insect pests are not present in intolerant numbers each year, the use of monitor traps may lead to the reduction in the number of sprays needed by indicating to the grower when sprays are necessary. Reductions in the use of insecticide sprays would also give natural parasites and predators an opportunity to survive and exert an important degree of natural control.

Continued work in this field will be

Glass capillary electrode connected to male moth's antenna. Base of antenna is positioned in a salt solution, which also contains a ground electrode.



Electroantennogram setup shows the injection of standard chemicals into air-stream passing over an antenna. Responses of the antenna (located in dish under microscope) are detected by the electrodes and displayed on an oscilloscope.

directed to finding sex attractants for key insect pests of other food crops. And it is hoped that such compounds will be incorporated into integrated control programs leading to better timing, or possible elimination of insecticidal sprays.

Addendum for the reader trained in chemistry: One of the ten destructive pests of the apple fruit is the codling moth. The larva of this insect is the common apple worm which tunnels through the apple flesh, destroying its quality for eating. In warmer climates this pest has 2 or 3 generations during each fruit growing season, and 1 or 2 in the North.

With codling moth males, it was found that the 12-carbon alcohol with a double bond in the 8-position and a 12-carbon alcohol with a double bond in the 10-position elicit greater antennal responses than all other standards. The *trans* configuration double bonds were better than the *cis* indicating that the attractants is probably *trans*-8, *trans* 10-dodecadien-1-ol. When this compound was synthesized, it attracted codling moth males in the field traps. ◆

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Do Plants "Cleanse" the Air?

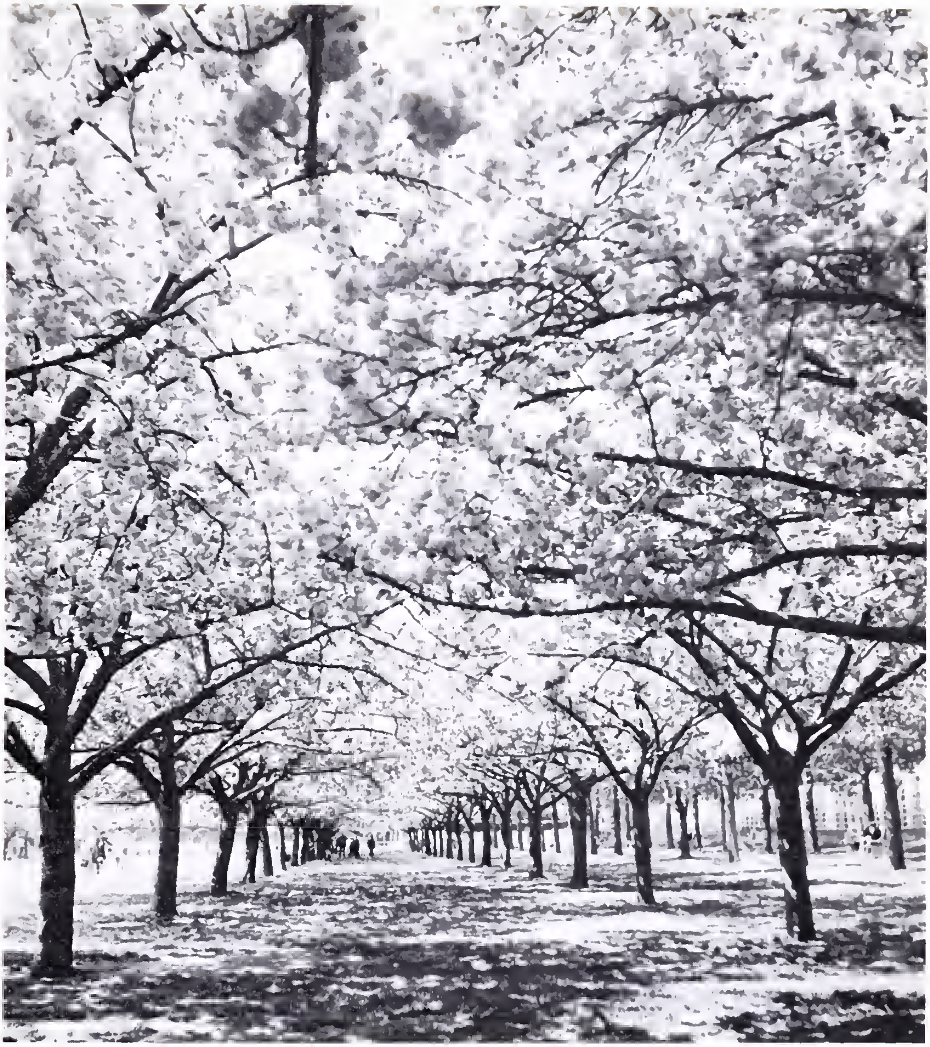
With the increased interest in ecology, a great deal of attention has been given in the press to plants "cleansing" the air. Unfortunately, rather few scientific data have been presented to support this thesis. Whether air pollutants can in fact be filtered out by green plants is the subject of a recently initiated research project at the U. S. Department of Agriculture laboratories in Delaware, Ohio. Present evidence from European laboratories indicates that sulfur dioxide, a toxic air pollutant, is absorbed to some extent by green leaves. Ozone also. ◆

New Life for Shrub Ivy

Ordinary everyday English ivy *(Hedera helix)* produces great numbers of adventitious roots along the stems of intact plants, yet the shrubby or tree phase of the plant, with flowers, produces none. "Shrub" ivy, while occasionally seen in New York, is more common in milder parts of the country. The unlobed leaves are quite distinct from typical ivy and the plant could be a useful addition to the rather small number of broad-leaved evergreen shrubs available to the gardener. However, it is difficult to propagate in sizable quantities, according to Brooklyn Botanic Garden propagator Thomas Hofmann. Now comes a report from Professor Wesley P. Hackett of the University of California at Davis. His research shows that under low light intensity or in darkness, cuttings of the shrubby phase treated with the plant hormone indoleacetic acid root sparingly; with catechol added, they root well. ◆

Preserve Your Leaves with Glycerine

You can preserve leaves several ways, including pressing them for a time between the pages of a heavy book or even by hanging them upside down in an aerated room, but their colors usually don't keep well. One method that is becoming increasingly popular in the United States as well as in my homeland, Japan, is to treat them with glycerine, which results in better color. Glycerine may be purchased at most drug stores. Buy enough to make a solution of one part glycerine to two parts water and fill to the brim a wide-mouthed container that is at least 4-5 inches deep. Soak the branches in it for several days to two weeks, depending on foliage thickness. Add more solution if evaporation occurs. Ideal time: July, or earlier in the growing season. You can try this with almost any kind of leaves, even those of house plants.—*Junko Ohkaya*



Season by Season in the Brooklyn Botanic Garden

Japanese flowering cherries in great variety grow at the Botanic Garden, but when the Kwanzans bloom in the first week of May, visitors focus on the fairyland of the Esplanade. Planted in 1941, the trees represent the most spectacular floral display in New York City. The photographs on these pages were taken by John Horn, a good friend and neighbor who has seen the Botanic Garden in all seasons.

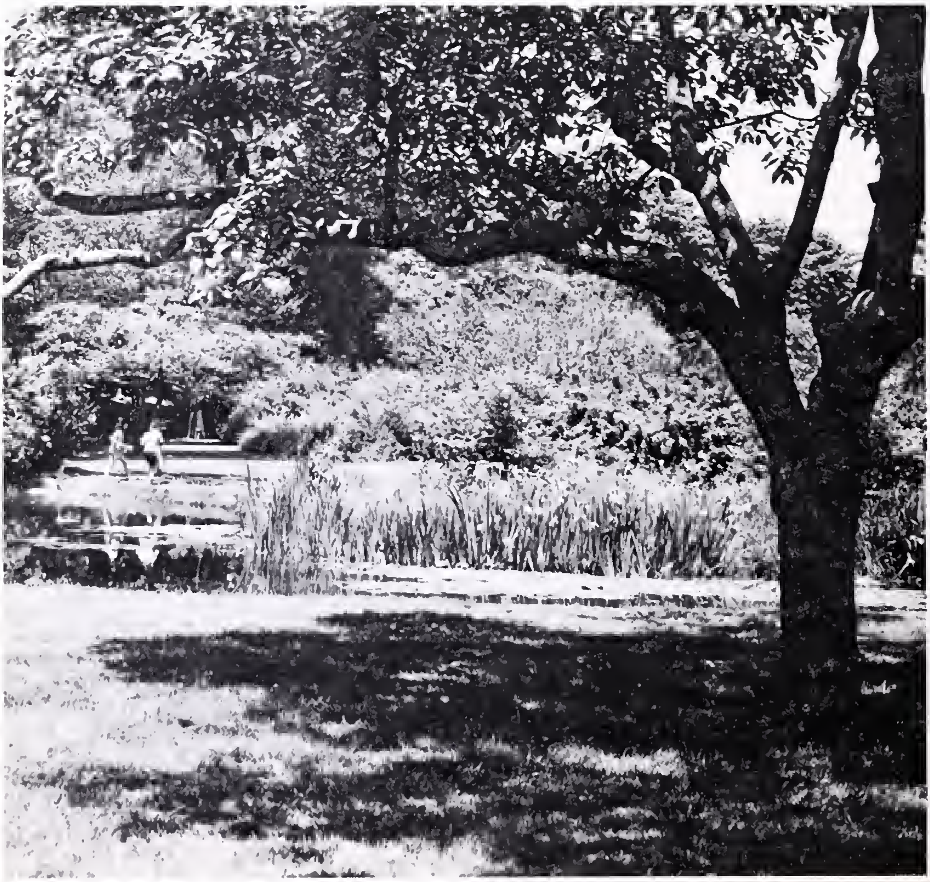
Above: Stone foxes guard Inari Shrine in Japanese Garden. *Below:* Wisteria forms soft ceiling of violet.

Above: The flowers in May sometimes give way to the newlyweds. *Below:* A spring day and a sunny bench provide the setting for quiet pleasures on the Overlook.

(Continued)

Left: Perhaps a solitary wanderer, impatient for warmer days, has gone his way to check the hoes and spades in the Children's Garden house. *Below:* Summer in the Brooklyn Botanic Garden provides a cool haven from the city heat and bustle. Huckleberry Finns of the 1970's still catch tadpoles in the brook, just a fifteen-minute subway ride from downtown Manhattan. This rustic part of the Garden was once an unattractive public ash dump.

Photographs by John Horn



The Control of Bark Beetles in Coniferous Forests

E. Sam Hemming

From American Nurseryman, April 15, 1971

POPULATION attractants refers to a whole new concept in the study of insect population movements, especially those of the bark beetle. The issue of *Contributions from Boyce Thompson Institute,* December, 1970, consists of 100 pages discussing and summarizing information on this new concept. The information contained in the issue was presented in the form of technical papers at a symposium in Freiberg, Germany. It is a subject which is opening up a new era in chemical ecology, according to Dr. J. P. Vité. Dr. George L. McNew, director of Boyce Thomspon Institute, Yonkers, N.Y., summarizes the work being done and outlines the discoveries that have been made to the present—discoveries which open new avenues toward control of insect pests.

According to Dr. McNew, bark beetles on forest trees cause up to five times the damage done annually by forest fires. The Institute has concerned itself with finding solutions to the problem of the bark beetle since 1956 and has spent over two million dollars on this research program. Boyce Thompson has established research stations directly within forests in California, Texas and Idaho to study the problem as it occurs.

Pressure Points

One of the first discoveries to be made in the study of control of bark beetles was that there exists a close relationship between the pressure of the plant's resinous sap and the susceptibility of the tree to attack by the beetle. If the sap pressure is high enough (often this can be found to measure six atmospheres or more), the tree can force resin into the beetles' tunnels. When the sap crystallizes, it can inhibit the development of the beetle infestations. (This self-protecting habit of the tree by sap pressure was found to correlate directly to the conditions in which it grows. The fertility of the soil and incidence of drought are both factors in the plant's "blood pressure.")

With this first discovery, it was found that the information could be used to practice selective logging with considerable accuracy on presumed doomed trees.

Signal Deciphered

Clearly, the great collective discovery reported here is that the southern pine, western pine and mountain pine beetles all use a system of chemical communication to select their host, signal mass attack, regulate their sex ratios, and prevent overpopulation of a single tree. When a few pioneering beetles attack a random-selected tree and are successful in infesting it, it may be noted that shortly thereafter (from a few hours to a few days) hordes of beetles will arrive at this same tree, abandoning their former site, which they have already destroyed. It was at first thought that the secondary, large infestation was attracted by sonic vibration.

It has been established, however, that a chemical pheromone is responsible. When chemical extracts from two different boring beetles were placed a short distance apart to test them, each pheromone attracted beetles of its own species, in pure collections. Through this kind of testing, it became possible to manipulate field populations of beetles by using artificially infested log sections.

Once these discoveries were made, it was necessary to find out the chemical composition of the pheromone and, if possible, to synthesize it. It was found that there are several different pheromones. These occur in the insect in a cyclic manner and do not always function as attractants. In certain cases, the host tree has to produce a chemical which, in conjunction with the pheromone, becomes the attractant.

Problems and Possibilities

There are other complications attached to the attraction process. The release of the chemical often changes. This leads to attraction of large numbers of females, then hordes of males and, finally, a type of deterrent which acts against the females. It is necessary to know in advance which beetle is being attracted, in order to key control methods. This cyclic attraction makes control difficult.

But, according to Dr. McNew, this series of discoveries offers several vistas of control. When beetles vacate a dying brood tree, they can be manipulated to attack a tree slated for lumbering, or they might possibly be trapped in some way. Control with pesticides is not considered desirable, since this also eliminates all the parasitic insects which aid in destroying bark beetles. It may be possible to develop an attractant which affects both the bark beetles and their parasites and thus gets the upper hand. It also seems possible to destroy the beetles in an attacked tree with an injection of a chemical called cacodylic acid. ♦

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Tree Propagating Missouri-Style

Gene Brunk is the Buffalo Bill of the Missouri Conservation Department's forestry division. Brunk is listed as a tree improvement specialist but he's known to most people as "The guy who shoots the tops out of trees." The reason Brunk shoots out tree tops is to get cuttings of such trees as cottonwood or black walnut or to check the pine cone crop.

Shooting down cuttings is an old timber improvement practice and is much easier and safer than having a man climb a prime tree and try to coax the ends off branches, while balancing precariously 100 feet off the ground.

"It costs me about four cents a cutting," Brunk says. "You have to know what you're doing. I've put up to 65 shots into a limb and it was still up there. The best I've ever done was a 4-inch diameter limb that I brought down with three shots.

"Most important thing is that the first shot be an undercut so when the limb breaks it doesn't hang on the tree. Then you start at the top of the limb and bang, bang, bang, down through it, just like a saw cut. Normally I pick one limb and if it forks enough, I can get 20 cuttings from it."

As serious as is the purpose of Brunk's work with his rifle, it's sometimes difficult to convince people of that.

Brunk remembers an incident near Welling. "I was looking up in a tree where I'd hung a branch up when a railroad crew came by on a handcar. They stopped and looked up for a while with me."

Finally, one of the men said, "What're lookin' for up there?"

"Im shooting tree branches," Brunk answered.

Silence. "What did you say?"

"I'm shooting tree branches off these trees."

Another silence. "That's what I thought you said." Long silence.

"Are you gettin' any?"

"Yeah."

"Oh." The crew looked at each other, quietly got in their handcar and disappeared in the distance. ♦

—*Kansas City Star*

Breeding for resistance to spruce gall—

An Alternative to Chemical Control

B. A. Thielges and R. L. Campbell

From Ohio Report on Research and Development, July-August 1971

THE eastern spruce gall aphid (*Adelges abietis*) is a serious pest of Norway and white spruce in Ohio and neighboring states. The feeding activities of the aphid cause the formation of unsightly pineapple-shaped galls at the base of twigs. This damage very seldom results in the death of a tree but repeated, heavy infestations may severely disfigure individual trees and destroy their value as ornamentals or Christmas trees.

At present, control of the eastern spruce gall aphid is achieved by the use of insecticides, but spraying is costly and time-consuming. It must be properly timed and must be prepared every year to be effective. Nursery trees which have been protected by insecticides lose that protection when purchased for use in landscape plantings, and the burden of control shifts to the homeowner.

An alternative to the use of insecticides would be the development of resistant lines of spruce trees as a more permanent and economical means of control. Eliminating the need for spraying would also be desirable from the environmental standpoint, especially in large plantations where wildlife might be affected and in home landscaping where children and pets must be protected.

A project has been initiated to investigate the possibilities of selecting and breeding Norway and white spruce for resistance to the eastern spruce gall aphid. Participants: the Department of Forestry of the Ohio Agricultural Research and Development Center and the Entomology Research Division, USDA-ARS, Beltsville, Md.

Plantation Surveys

Surveys were made of Norway and white spruce plantations in Ohio and West Virginia from 1968 to 1970. Trees in plantations were randomly sampled and the relative numbers of galled and gall-free trees were determined. A total of 900 trees were evaluated at nine locations. Individual gall-free trees are often found in the midst of heavily galled trees. These trees have remained free of galls for up to five seasons despite heavy infestations on surrounding trees. Although gall-free trees support over-wintering aphids, the trees are not galled in the spring. This suggests that there is some factor present in these trees that either prevents the aphids from surviving the winter and laying eggs in the spring or inhibits the hatched nymphs from feeding on the developing foliage.

A further observation is that the ratio of galled to gall-free trees is approximately 1:1. This ratio was similar in many different plantations, and of the 900 trees evaluated, 49 per cent were galled and 51 per cent were gall-free. Genetically, this ratio would occur if resistance to the eastern spruce gall aphid is controlled by a single gene (with two alleles and no dominance).

Hybridization Tests

To test this hypothesis, galled and gall-free trees have been selected for breeding experiments. The program was begun in 1970 with controlled pollinations on white spruce growing in the Secrest Arboretum. Pollinations yielded seedling progeny in all of the mating combinations—galled x galled, galled x gall-free, gall-free x gall-free. In two years these seedlings will be infested with the spruce gall aphid. The resulting ratios of resistant to susceptible trees in each progeny will be compared with the ratios expected under the genetic hypothesis.

The pineapple-shaped growth on spruce trees is caused by feedings of an aphid.

Controlled pollinations were continued in 1971. In addition, selected trees were propagated by rooted cuttings. These clones will be used for further resistance testing. If the progeny tests identify valuable parental types, clonal material of these will be available. This could shorten the time needed to establish seed orchards and produce improved seeds.

If resistance to the eastern spruce gall aphid proves to be genetically controlled, resistant clones of Norway and white spruce can be developed by rooted cuttings or by grafting. When the mode of inheritance is determined, seed orchards can be established for commercial seed production. The use of resistant spruce planting stock would eliminate the need for chemical control of the spruce gall aphid. ♦

Prairie Wildflowers

Mrs. Austin M. Zimmerman

From the Garden Club of America BULLETIN, January 1971

LESS than one hundred and fifty years ago the first settlers came out of the woods to dwell in the prairie, uneasy at first in this strange new world. Soon a steel plow that could turn the heavy grassland sod was invented. Within the short time of one or two generations the prairie was gone, the native grasses and the flowers replaced by the grasses that feed men. The wave of settlement spread west.

Those first settlers were lyrical in their description of this unfamiliar, treeless land. They likened the sweep of wind across the grass to the restless movement of the sea. Most of all they marveled at the brilliance of the flowers as one wave of color replaced another from spring to late October.

In May when the new grass was short, the pink and white of shooting stars blanketed the prairie, enhanced by the lavender of violets and the golden stars of the yellow-star grass. Summer flowers made a rainbow of color—the fiery trumpets of prairie lilies, the royal blue spikes topping the dainty gray foliage of leadplant, the deep pink of purple coneflowers, and the handsome white heads of wild-quinine. By September the grasses had grown as tall as the people who walked there. The flowers had the rich muted tones of autumn, the deep yellows of sunflowers and goldenrods, the lavenders and purples of asters and ironweed and Joe-Pye weed.

Finally, when the flowers were gone, there remained the golden russet of prairie grass under a gray November sky.

Today there is almost nothing left of one of the major plant communities of North America, the prairie vegetation that stretched from Canada to Texas and from the Rockies to Indiana. Only little bits and pieces remain—along railroads, in old neglected cemeteries, on land too rocky or too wet to plow.

Those of us who live in the Midwest should certainly include prairie flowers in our wildflower study projects. Best of all, let us try growing them from collected seed. Prairie flowers are not at all hard to grow from seed. Many plants can still be found in crannies and corners.

Perhaps we can do more than preserve a few prairie plants. Last spring I went to Texas, forlornly hoping to find a few blue-bonnets. Imagine my amazed delight to find, not a few, but literally seas of bluebonnets along every Texas highway. And paintbrush, and ragwort, and other Texas wildflowers in great sheets of color. Enquiry revealed that the Texas highway department is responsible for this miracle—they plant three hundred thousand pounds of wildflower seeds every year along their highways, and they sent me a leaflet telling me how they do it.* If Texas can do this, so can the rest of us.

What lovelier cover could there be for the roadsides of our new expressways in the prairie states than the native prairie vegetation? And what more practical one? Drought is no enemy of prairie plants as it is of the foreign grasses and the trees and shrubs I see being planted along these highways now, many already forlornly dead. Nothing holds the soil so well as the deep, extensive root systems of prairie grasses. Weeds find no place to grow in a mature prairie.

Extensive prairie restorations have been achieved at the University of Wisconsin Arboretum at Madison and at the Morton Arboretum in Lisle, Illinois. The know-how is available. ◆

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* *Flowers of Texas*, free for the asking from Texas Highway Dept., Travel & Information Division, Austin 78703. Also available: *Prairie Propagation Handbook*, $1.25, from Boerner Botanical Gardens, Hales Corners, Wisconsin 53150.

Tree-shaded property? It can be the beginning of a

Wildflower Garden

Marjorie J. Dietz

From Flower and Garden, May 1971

FORTUNATELY today many builders know the value of existing trees, and make efforts to spare them when developing properties for houses. Such wooded areas then provide welcome shade for the welfare of new home owners, as well as an opportunity to create a wildflower garden—one of the most satisfying experiences in the world of gardening. It has the added advantage of involving as much or as little effort as you, the owner, wish to expend. It can be completed in one or two seasons, or it can become a pleasant pastime for all seasons.

A woodland garden can be a modest project limited to the most accommodating of native plants clustered under a few trees or large shrubs, or if can involve an entire property with as many kinds of native plants as you wish.

Because of today's emphasis on the conservation of natural beauty and environment, preserving trees and the other plants accompanying them has special meaning. Establishing a wildflower garden around your own home is one way you can involve yourself personally with conservation.

In some cases a wildflower garden may be well under way because many suitable plants are already there. Much depends, of course, on how the builder protected the land as he was building the house. Even if he was heedless, you may find desirable plants along your property boundaries, or close to trees.

For those to be added, the best source will be nurseries that specialize in native plants. Even general mail-order nurseries often offer selections of natives, especially among ferns. Digging of plants from private property or sanctuaries is completely contrary to the conservation code; but from roadsides or other areas subject to mowing or construction, it is usually permissible and well within the true spirit of conservation. Spring or fall are the best collecting seasons, especially after a soaking rain. Put plants into plastic bags to prevent their roots from drying; and replant as quickly as you can.

A wildflower garden may be merely a small, irregularly shaped island, between two or three shade trees. In a more extensive wooded area, you can mark out a path or series of paths. They should meander the same as do woodland trails you may have followed. Surfacing the paths with pine needles, fresh sawdust or wood chips makes them more attractive to look at as well as inviting to walk upon. As the material on the path wears, it can be removed to become a mulch for the plantings which require a never-ending blanket of humus.

The trees themselves play a part in the layout of paths. Occasionally one may have to be removed, as will lower branches of some trees to improve the vista and create "high" shade so light and even filtered sun or patches of sunshine penetrate the home forest.

Underbrush and seedling trees must be thinned or removed. Certain native vines —Virginia creeper and catbrier, for instance—are effective plants for some locations, but they can quickly get out of control and smother choice wildflowers. You must grub out their roots; otherwise after being cut back they spring back all the stronger! You may want to add a few native shrubs not already present. The oak-leaf hydrangea (*Hydrangea quercifolia*), native viburnums, summer-sweet (*Clethra alnifolia*), and several kinds of native deciduous azaleas and evergreen shrubs such as rhododendrons, leucothoe, and pieris are all suitable.

In most home woodland gardens, large-scale soil preparation—such as is required when establishing a lawn or perennial garden—is neither desirable nor needed. An exception might be when the builder has dumped inhospitable subsoil in the area and has even raised the ground level around tree trunks. Usually, though, the soil can be prepared section by section as your planting plans progress. Special soil conditions occasionally must be provided for some plants, but most woodland plants prefer an acid, humus-rich soil which does not remain soggy, yet retains a reasonable degree of moisture. Ideally, some clay should be present; very sandy soils, even when improved with addition of peat moss, will require extra watering during droughts.

In areas where falling leaves have been accumulating for years to form layers of leafmold, the only effort required by the gardener is to fork over the planting section lightly, dig holes and set out the plants. When the soil is sandy or the other extreme—too heavy, more effort is necessary to prepare the humus-rich soil so vital to most native plants. Mix in peat moss—enough so you can feel with your hands the improved texture of the soil. Other sources of humus are rotted sawdust or decayed wood chips, leafmold collected from nearby areas or any decomposed material you may have at hand.

Most woodland plants are best when in colonies—as they grow in nature. A small garden, such as the "island" mentioned earlier, might include a few tall accents such as the interrupted fern (*Osmunda claytoniana*); several kinds of trillium (I especially like the white *Trillium grandiflorum*); American columbine (*Aquilegia canadensis*) and Virginia bluebells (*Mertensia virginica*)—for a red, white and blue spring color scheme. Additional

A tree-shaded property, whether extensive or of limited area, can readily be converted into a wildflower garden. Among the natives introduced to this oak-shaded property are Mayapple, foamflower, Christmas fern and wild ginger.

10 NATIVE PLANTS TO PROPAGATE

PLANT	METHOD	SUGGESTIONS
Bluebells (*Campanula rotundifolia*	Seeds	Buy plants and let them self-sow. Or buy seeds; plant in spring or fall. Excellent among rocks.
Cardinal-flower and Great Blue Lobelia *Lobelia cardinalis* and *L. siphilitica*)	Seeds	Buy plants; both species will then self-sow. Buy seeds; plant in spring or fall. Easy.
Columbine (*Aquilegia canadensis*)	Seeds	Buy plants; let seed capsules form. Plant seed in fall. Or plant will self-sow freely. Also collect seed from plants in wild.
Foamflower (*Tiarella cordifolia*)	Division and rooted runners	Buy plants; thereafter divide in spring. Or sever rooted runners and replant. Attractive ground cover under trees in humus-rich, moist soil.
Galax (*Galax rotundifolia*)	Division	Buy plants; set out in humus-rich soil. After plants are established, lift in spring or fall; carefully separate so each section has one bud; replant in humus-rich soil. Evergreen foliage makes this a popular colonizer under trees.
Mayapple (*Podophyllum peltatum*)	Division	Buy or collect a few plants, then lift and divide fingerlike rhizomes in spring. Excellent under trees, but foliage dies down in midsummer.
Shortia (*Shortia galacifolia*)	Division, cuttings	Buy plants. When clumps are well established, carefully divide in spring. Replant in humus-rich soil kept moist to help divisions form new roots. Or take stem cuttings after flowering through early summer. Insert in box or flat filled with peat moss and sharp sand. Water. Maintain a polyethylene "tent" over box. Set out plants following spring in humus-rich soil.
Solomon's seal (*Polygonatum*)	Seeds, division	Buy plants or collect. When seeds (inside berries) are ripe in fall, sow. Or divide iris-like rhizomes in spring or fall.
Trailing-arbutus (*Epigaea repens*)	Cuttings	Buy plants or collect (carefully dig) "sods" of the plants. Must have acid soil. Mulch with pine needles or oak leafmold. Take cuttings in midsummer and insert in polyethylene-enclosed flats as recommended for shortia cuttings. **Foolproof method:** Wrap each cutting's stem with sphagnum moss (tie with thread), then insert in flat.
Wild-ginger (*Asarum virginicum*)	Division	Buy plants. Then divide clumps (dig deep as fleshy roots are long) in fall or spring. Plant in humus-rich soil. This species has heart-shaped evergreen foliage, often mottled. A slow-spreading, but handsome, ground cover.

Photographs by author

Shortia, a ground-hugging evergreen with white flowers in spring, needs shade and humus-rich soil. This patch has spread from a small clump purchased from a nursery.

plants might include Jack-in-the-pulpit (*Arisaema triphyllum*) and such ferns as the Christmas fern (*Polystichum acrostichoides*) or the delicate maidenhair (*Adiantum pedatum*).

In the larger woodland garden, the choice widens to the ever-fascinating mayapple (*Podophyllum peltatum*), foamflower (*Tiarella cordifolia*) and even the skunk-cabbage (*Symplocarpus foetidus*). The last is associated with wetlands, but it adapts to drier soil rich in humus. It is a fascinating plant to watch as its development keeps pace with spring—first the strange flowers as snows recede, then the unfolding of the foliage.

The strikingly beautiful red cardinal flower (*Lobelia cardinalis*) and its relative the great blue lobelia (*L. siphilitica*) flower over a long period in summer, and are handsome subjects along brooks (if you are blessed with such!) or by manmade pools. The closed or bottle gentian (*Gentiana andrewsii*) may lack the fragile beauty of the fringed gentian (*G. crinata*), a biennial that must be painstakingly grown from seed, yet it is a lovely blue perennial for autumn. Many natives that bloom in spring offer fall interest with their berries. Jack-in-the-pulpit has eye-catching clusters of bright scarlet fruits; false solomon's seal (*Smilacina racemosa*), red speckled berries; and true solomon's seal (*Polygonatum* species), dark blue berries dangling along arching stems.

The idea of propagating native plants seems novel to some gardeners who otherwise are quite familiar with ways of increasing cultivated plants. Methods are the same: seeds, cuttings and divisions. Most natives are as easy to increase as cultivated plants. But there are some, especially among the orchids, whose increase is best left to nature. This is why conservationists abhor even the picking of flowers of such rare plants, as each plucked flower means one less seed pod.

Generally among the easiest natives to propagate by simply lifting and separating—either in fall or just after flowering—are violets, false lily-of-the-valley or Canadian mayflower (*Maianthemum canadense*), blue phlox (*Phlox divaricata* and *P. stolonifera*), partridgeberry (*Mitchella repens*); Jacob's ladder (*Polemonium reptans*); most asters and other members of the daisy family; and many ferns. A knife or pruning shears will help, but some clumps can be carefully separated into smaller sections by hand alone. Such divisions must then be treated as you would any plant which has undergone surgery: plant at once in freshly prepared soil, water well and thereafter as necessary. ◆

How To Stabilize A Woodland Path

Alan Taylor

From Home Garden, April 1971

If you are fortunate enough to have a wooded section at the end of your yard, even though it comprises only some half dozen trees, a straight walk is not in harmony with the setting.

What is wanted is something that winds—narrow in some parts and wider in others—something with irregular edges, enabling bluebells, violets and primroses to spill over in confusion to make the footway still more pleasingly irregular—like a well-worn path through a woodland glade. Above all, you will want a surface firm and clean to walk upon, easily and quickly laid, and one that will not necessitate the carting of material over a very long distance.

A soil-stabilized path can be the solution to the problem. It involves a process employing soil and you have only to add a little cement and, perhaps, a small quantity of lime. A rough wooden framework to keep concrete in position until it has set is not needed, and you can do your mixing on the spot. The process is employed by armies throughout the world and by some airports as well.

Mark out the proposed path, grub out weeds and rake clear. Remove about 3 inches of soil from the surface. Break it up finely and toss into convenient heaps in the middle of the site of the path. For gravelly earths, sprinkle on each heap about one part by volume of cement to each 10 parts of soil. Clay and loam will require the addition of lime—one part to each 20 parts of soil, mixed well together, and then one part of cement sprinkled over 10 parts of the mixture. Between these two extremes you will be able to decide upon a formula to suit your particular soil.

Mix each heap in a dry state and rake out level. Sprinkle water on top through the fine rose of a watering can or a mist nozzle and mix again, this time quickly, using the shovel flat so that you will not dig down too deeply. Then roll the surface firmly and leave for three or four days to harden.

If you have a rotary cultivator there is no need to shovel the topsoil into heaps. With loam or clay, just sprinkle the lime on top and till. Then sprinkle cement and till again. Then sprinkle water and till again. And, finally roll it firm.

You can give a small plot apparent increased length by planning the path to twist around trees and large shrubs and by exaggerating the perspective.

For example, when you look down the length of a straight highway, one of the ways you judge its length is by noting its apparent width at the end and comparing it with the width at the part nearest you. The comparison is deliberately made. You have become so used to the phenomenon of two parallel lines appearing to meet eventually at a distant point that the process of noting it has become automatic. You can take cunning advantage of this optical illusion by building your path narrower at its farther extremity and by so doing make it appear longer than it actually is. ◆

Enjoying native plants in the city . . .

Wildflowers on a Balcony

Thomas H. Cain

From Horticulture, September 1971

THE frustration of living in an apartment and not being able to garden is especially acute if one's gardening interests include the growing of wild plants. My wife and I found ourselves in this situation recently when for two years we were unable to find the sort of house we wanted. But during this time we found that it was possible to grow wild plants successfully in a box on an apartment balcony.

This experience was rewarding in several ways. First, it caught gardening and other friends off guard. Nobody expects to come to dinner in an apartment in March and see spring's first hepatica blooming cheerfully on the balcony. Secondly, it is psychologically helpful in the middle of the commonplace, standardized milieu of apartment cubicles to look out one's sliding thermopane windows and see what appears to be a small but flourishing slice of the forest floor. Finally, one's proximity to the plants themselves makes individual wild flowers (which may seem insignificant in the woods unless in colonies) appear as distinct and delicately organized specimens that invite a closer look.

Because I have never heard of native plants successfully grown in apartments, it is important here to explain the microclimate afforded by our particular conditions. In this rather protected part of southern Ontario, typical winter temperatures are 10 to 40° F but sometimes dip to —20 or even lower.

Our balcony faced east and south and, so, was sheltered from west and north winds. The balcony above and the building itself shaded it heavily and during summer nearby trees to the east and south cut off almost all the morning sun received in the winter and spring. Since the plant box adjoined the heated wall of the next apartment, it must have received some heat in winter in addition to sun, as well as reflected heat, and so have been subject to thawing and freezing in spite of its heavy leaf mulch.

Our planter was a wooden box about 18 inches high, 2 feet wide and 10 feet long. We put a 3-inch layer of gravel in the bottom and filled the box with potting soil produced by a local sod farm. To this we added some bonemeal and considerable peat moss. Although pH was not measured, it was probably just slightly on the acid side, like the soil of the local woods (a maple-beech climax), whose flora we tried to reflect. We made no attempt to grow distinctly acid-soil plants like trailing arbutus. After planting and watering I felt (wrongly, as it turned out) that I had added too much peat and so drilled large holes in the walls of the box to help aerate the soil. This created an unfortunate Swiss cheese effect which was partly masked the next spring when we planted small ferns and wild strawberries in the holes.

We moved into the apartment in September and planted the box in the same fall. Some plants we bought, some were given to us by friends and others were collected by permission from large stands. During the first winter the combination of a few Christmas and shield ferns protruding from the permanent maple-leaf mulch gave some suggestion of the woods.

The first plant to bloom was *Hepatica americana* which appeared in the first week of March, one whole month before the same plant bloomed outdoors on the sheltered side of the nearby Niagara Escarpment. *Claytonia virginica* produced a pretty clump from a couple of tubers and then *Trillium grandiflorum* bloomed in its noble way in two handsome clumps. A tiny *Anemonella thalictroides* was so delighted to be moved from a rocky hillside that it decided to flower repeatedly until midsummer (its double pink version, sometimes available in wild-plant commerce, would probably have been even more attractive).

Some other spring plants that made good showing were *Cypripedium parviflorum, Viola canadensis* and *Tiarella cordifolia.* Such a delicate plant as bishop's cap, *Mitella diphylla,* not only appeared to advantage but before the box was dismantled had already begun to seed itself. For some inexplicable reason we lacked bloodroot, *Sanguinaria canadensis.* Its long-lasting exquisite double form would have been as showy as the trilliums in such an arrangement.

After the spring plants bloomed various strategies were possible for creating summer and autumn effects. In boxes that contain some ferns as well as plants of contrasting foliage patterns such as thalictrum and wild-ginger, a varied, cool foliage design results. It is more interesting, however, to introduce a few plants that will bloom as single specimens in the summer or produce berries in the autumn. For us three small purchased bulbs of *Lilium canadense* provided tall, swaying, architecturally intricate movements against the brick wall.

If we had stayed longer I would certainly have tried *Lobelia cardinalis*, its more adaptable blue relative *L. siphilitica*, and *Gentiana andrewsii.* One surprising and unplanned-for plant was *Eupatorium rugosum* which arrived somehow as a seedling and in its second autumn provided a month of handsome fluffy white flowers delicately arranged above the dark stems. In the wild this plant usually is attractive only in mass effects, but with a little feeding and one midsummer pinching it becomes an elegant, if underestimated, specimen plant. Near fuchsias it is subject to whitefly but without apparent damage.

In the fall, berried plants produce a good effect. Familiar Jack-in-the-pulpit gives a fairly long-lasting scarlet cob as a culmination to its curious spring flower and summer-long tropical foliage. A group of three in fruit is splendid at close range. Probably the best bet for winter berries, however, is the blue cohosh, *Caulophyllum thalictroides,* with its nodding purple spring foliage, delicate summer leaves and, throughout most of the fall and winter, rich blue-bloomed fruits and pedicels on pale straw-colored stalks. The plant we began with was too tiny to come to fruit in two years but, if one began with a small flowering clump fruiting would occur at once. For us a little group of *Polygonum biflorum* with its drying blue twin-berries and papery winter leaves gave an arching but less colorful version of the same effect beside the window.

A different summer solution would be to interplant the wildflowers with ordinary shade-loving garden plants such as fuchsias, browallias, impatiens and begonias. We did not try this. Instead, we moved to a rural house! In dismantling the box and removing the plants we found the soil full of decayed, roasted peanuts in their shells—apparently collected by squirrels from birdfeeder handouts and secreted with their usual forgetfulness. If we had stayed long enough the peanuts would no doubt have become part of an annual organic addition to the soil. Our box would thus have become analogous to the self-fertilizing forest.

Our balcony situation was protected and shaded, but I see no reason why someone living with a more windblown and sunny balcony should not succeed in growing the wild plants natural in that kind of situation. Suitable plants would include ox-eye daisy, black-eyed Susan, St. John's-wort, chicory, *Monarda fistulosa* and various field asters. In fact, the wildflower box could probably be adapted to such sites as patios, condominium enclosures and, indeed, anywhere where a gardener wishes to grow wild plants and see them continually at close range from his living room or kitchen. ◆

Rock plants are finding places in the levelminded garden world

Rock Gardening for Flat-landers

Donald E. Havens

From FLOWER AND GARDEN, June 1971

OLD IDEAS die hard. With many gardeners the idea still persists that a rock garden has to be a miniature Matterhorn populated with plants from the highest peaks. To modernize our thoughts, we can first discard the misconception that alpine or rock plants have to grow from crags. Many true alpines prosper without being anywhere near rocks. They may come from mountain meadows where few stones are seen. Those that associate with rocks are satisfied by having the stones below the soil surface around them and by a stone chip mulch around them.

It helps to realize that not all alpines are rock plants, and not all rock plants are alpines. What we are talking about here are plants from any elevation requiring association with rocks—whether they occur naturally in mountains, meadows, woods, prairies or streamside. By tradition they are all hardy perennials. Most do come from uplands where they have never been required to swim.

Growing the plants does require study: Learn how tall they grow, how far they spread, what soil type and exposure they need. I recommend a good book such as H. Lincoln Foster's *Rock Gardening,* (Houghton-Mifflin, 1968). Then organize them into groups to be placed in planting situations matching their needs.

If you select well, you can grow a great number of rock plants needing the one basic set of conditions, which are:

Loamy, friable soil containing ample sand or grit

Open airy space exposed to morning sun or sun filtered by high thin trees

Protection from sweeping winds

Moisture during the growing season

Any trees should be far enough away so roots do not encroach. For wind protection, a shrub border 10 feet away is ideal. For moisture, where nature does

H. Lincoln Foster

Unique garden of Dwight Ripley combines raised beds and containers in which to grow rock-garden plants. Large sections of sewer pipe are the containers. The entire garden is enclosed by a wall to form a protected, sun-drenched court.

not provide, man must, but usually only in the spring months, as many choice plants grow fast, bloom, set seeds and are ready for drouth by mid-July. If you want plants from high plains and prairies, group them together so you can give the sharp drainage and summer baking most of these require.

I suggest two basic methods for growing rock plants on flat land—in grade level beds, and in raised beds. Whichever you are making, the main steps are the same.

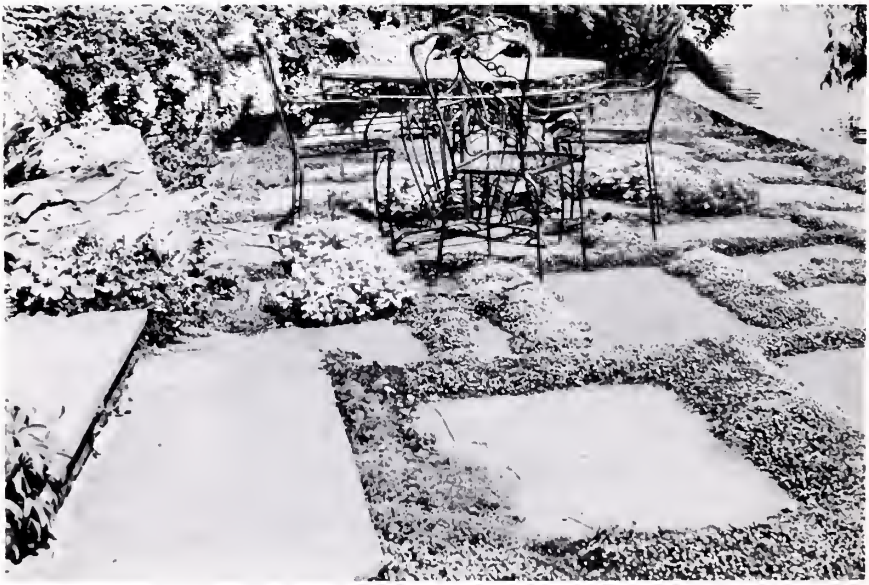
Grade Level Beds

For a ground bed, begin by excavating clay soil (if that's what you have) 30 to 36 inches deep and carting it away. Fill the hole a third to half its depth with broken bricks, concrete, or sharp stones that will not fit closely together. Over this place 3 inches of hedge or fine shrub trimmings, coarse straw or inverted turf sods; or lacking this use hardware cloth and then 3 inches of walnut-size gravel. Above this should be space for 18 to 20 inches of growing mix. Such depth is not a hard and fast requirement, but many plants have tap roots and need this space. Depth of drainage foundation also follows no hard and fast rule, and if natural soil drainage is good you could reduce this amount.

For the growing mix into which the plants go, I use seven parts loam, three parts peat moss and two parts sharp mason's sand.

One pleasing type of ground level rock garden is a walk-about pavement garden. This involves appropriate positioning of pavement stones or flags, with planted pockets between. Select a site compatible with your outdoor-living scheme.

Lay the stones first in any acceptable way for your climate to prevent heaving. For the plant pockets, first dig out up to 24 inches (if soil is heavy clay). Put in 6 inches of drainage material; invert turf sods over it. Fill in the rest with the growing mix described before, filling to 3 inches above surrounding ground level; let it settle to 2 inches, then start plant-



Marjorie J. Dietz

Variation of walk-about pavement garden of rock garden plants between flagstones.

20 FAVORITE ROCK PLANTS FOR PAVING OR WALK-ABOUT BEDS, RAISED BEDS, OR CONTAINERS

Achillea	—Several dwarf kinds; silvery foliage with heads of white or yellow flowers.
Aethionema	—Low shrubby evergreens with pink or white flower heads. (Persian candytuft)
Anacyclus	—Diminutive daisy. White-yellow flowers above mats of fine-cu foliage.
Androsace (rock-jasmine)	—Tiny silvery tufts with dainty pink-white flowers in spring.
Antennaria (pussy-toes)	—Furry pink-white flower balls on thin stems above flat silver foliage mat.
Anthyllis	—Low vetch-like gray plants with dense heads of red or yellow flowers.
Arenaria (sandwort)	—Mossy creepers starred with white blooms in spring.
Armeria (thrift)	—Dense tufted rosettes with rosy or white ball heads, wiry stems.
Artemisia	—Rock forms are low, grown for gray foliage.
Aubrieta	—Tufted green mat with heads of violet flowers.
Campanula	—Spreading low mats, bright green, studded with blue or white bell flowers.
Dianthus	—Many rock forms—green mats sending up rose, pink, white flowers.
Draba	—Dense yellow or white cress-like flowers above tiny foliage mounds.
Erinus	—Flat evergreen tufts with racemes of rosy or white flowers.
Geranium (cranesbill)	—Rock forms are low creepers with wide white to rose flowers.
Globularia	—Low mats of stiff leaves send up dense flower balls of blue.
Helichrysum (everlasting)	—Rock forms are woolly trailers with papery white or yellow flowers.
Linaria (toadflax)	—Rock forms are low tufts with snapdragon-like violet or pink flowers.
Mazus	—Lax, flat creeper with purplish snapdragon-shaped flowers.
Phlox	—Rock forms are stiff cushions starred with white, pink or blue flowers.
Potentilla	—Rock forms are little clumps of green or gray fingered leaves and white or yellow (sometimes red) flowers.
Satureja (savory)	—Rock form is a branchy low mound, aromatic with purple lipped flowers.
Saxifraga	—Silver or green mats raising airy wands of white to red small flowers.
Sempervivum	—Clustered fleshy rosettes of green to bronze, occasionally blooming slender cymes of pink-white flowers.
Sedum (stone-crop)	—Creeping mats of fleshy small leaves, starred with white, pink or yellow flowers.
Stachys (lamb's-ear)	—Woolly ground huggers with stiff spikes bearing small lavender flowers.
Thymus (thymes)	—Woolly or green, low and shrubby, with white to rosy small flower heads in summer.
Trifolium (clover)	—Rock forms are low, sometimes bronzy, with white, yellowish or red flower heads.
Tunica	—Spreading tufts of tiny dianthus-like plants, white to rosy flowers.
Veronica (speedwell)	—Mat-former of glossy green or silver foliage with tapered spikes of blue, rose or white.

ing. Some of the plants set near the stones will grow out over them creating a soft pleasing effect.

Walk-about gardens are flexible and adaptable to the size, shape and use of the area. Where traffic is heavy, space stones closer and plants farther apart.

Except in backgrounds and margins of the area, mature plants in such gardens should not exceed one foot in height; most of them should be low tuft- and mat-formers that spread modestly. Choose for contrast of textures. I prefer to avoid obvious pattern and uniformity in the plantings and in the placement of the stones. Add to the plantings an occasional stone of compatible texture, 4 to 6 inches thick at its largest dimension. This can give a little base shade for plants requiring it.

In Raised Beds

These have many advantages for growing rock plants. Maintenance is easy. Plants are nearer eye level—a help in seeing them, since many are midgets. Drainage problems are eased. And the multigrade levels of many contemporary homes create excellent opportunities for adapting raised beds.

A good height is 24 to 30 inches—both pleasing and convenient. For a bed this high, dig out 6 inches below ground level before starting the wall construction. Then build an enclosure. For the sides of a raised free-standing bed, you can use stones, cinder blocks, railroad ties or whatever else is at hand. Build it like a dry wall, unmortared with space between units to insert roots of tufted and trailing plants, packed with soil as you build the wall. The stones are always tilted inward so water drainage is to the inside and then down. This keeps soil from washing out of the enclosure. Fill the interior of the enclosure with drainage and soil layers the same way as in the excavated ground-level bed.

Whether your dry wall is of limestone or non-alkaline material will not matter to any of the plants in the adjoining list. Also, you need not be concerned about soil reaction from stones set into the surface. Embed these stones with 2 or 3 inches of them below surface. Place plant with root ball against the stone. If it is bare root, puddle it next to the rock, let settle, and fill mix around root and stone. Mulch the surface from crown to outer edge of leaves with a mixture of equal parts humus and stone chips. Chips should be 3/8 to 5/8 inch, depending on size of plant.

If you want to grow acid-loving plants, then avoid using limestone in the dry walls. The same soil mix as suggested may be used, but for the surface mulch combine nonalkaline stone chips (such as turkey grit), with equal parts of peat moss and cotton seed meal. Replenish mulches annually.

If you have failed with lime-hating alpines (or rock plants), the reason may be your alkaline or neutral soil, particularly likely in prairie and plains areas or other places with high soil pH. If you suspect the alkalinity problem, put in about two quarts of gypsum to each wheelbarrow load of the mix.

An adaptation of the raised bed idea is the container garden. You can create spectacular effects with ordinary kinds of containers. Sewer pipe sections, for example, make good planters. They are widely available, and come in clay, concrete or transite. Usually circular, they range in diameters and in sizes from 24 to 36 inches long. Stood upright, they give a raised planting surface nearly waist high. Unless placed over clay, hardpan or other impervious surfaces, they need no special attention to drainage if the above soil mix is used.

To be sure your project remains enjoyable and does not turn into hard work, limit the size of your project, or take it in easy stages.

To learn more about rock gardening on any level, join the American Rock Garden Society. It has an excellent Handbook, quarterly Bulletin, and a seed exchange—all helps in fostering wider possibilities and success in growing rock plants. For a membership application write to Richard W. Redfield, Secretary, American Rock Garden Soc., Box 26, Closter, N.J. 07624.

In hybridizing

Bumblebees Help the Plant Breeder

Richard A. Jaynes

From Connecticut's Frontiers of Plant Science, May 1971

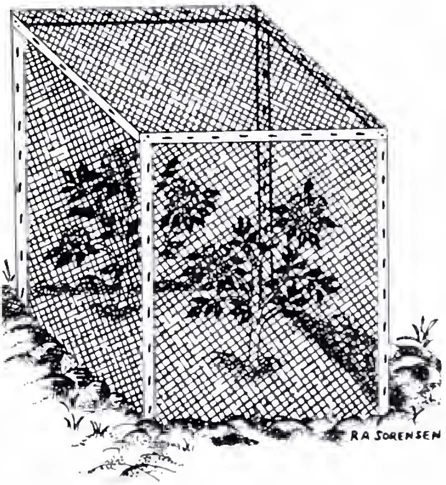
MOUNTAIN-LAUREL, the Connecticut state flower, is widely used in landscaping gardens and parks. It is one of ornamental horticulture's really superb evergreen shrubs. Over the last 100 years selected varieties of horticultural merit have appeared, but have never been widely distributed to the public because of the difficulties in propagation by cuttings. By learning how to reproduce the best forms of mountain-laurel from seed, an alternative means of propagation becomes available. Bumblebees can be very helpful in this.

Ten years ago a breeding program was begun with mountain-laurel (*Kalmia latifolia*) and its relatives. It is now beginning to yield practical information. We first wanted to discover which of the seven species in the genus *Kalmia* could be intercrossed. At the same time, cross pollinations were made between plants of the same species to determine how outstanding flower and foliage qualities were inherited. Progress on the breeding work was slow because it may take as long as six years to get blooming plants from seed. We learned, however, that certain selections of mountain-laurel and sheep-laurel (*K. angustifolia*) will come true from seed. Red-budded mountain-laurel is one of these; outstanding forms can be reproduced from seed by crossing a red-bud by a red-bud. White flowering selections appear to be reproduced in a similar fashion. Results with some of the deeply pigmented pinks are not yet far enough along to know if they can also be bred true to type.

Hand pollinations are all very well for a scientist if he only needs enough seeds for a few dozen plants from a cross, but what about the nurseryman or seedsman who may want a large number? We have learned that the common bumblebee will make the pollinations for us. Before the flowers open, a screened cage is placed over the two plants to be crossed. When the flowers are open on both plants, one or two bees, gently washed to remove foreign pollens, are introduced into the cage; *they* make the cross pollinations. Fortunately, self fertilization does not normally occur if the flowers are cross pollinated as well as self-pollinated. Honey bees also make good pollinators but they live only a day or two away from their hives.

Cuttings for propagation also can be taken from young seedlings before they have bloomed. Such cuttings root better than those from old plants.

Color photographs of mountain-laurel selections and the research report are available in Circular 240 of the Connecticut Agricultural Experiment Station, Box 1106, New Haven, Conn. 06504. ♦



Screened cage over kalmia excludes pollinating insects but confines bees.

The effect of mist on the

Autumnal Response in Plants

H. B. Tukey, Jr. and Choong Il Lee

From New York's Food and Life Sciences, April-Sept. 1971

RAINFALL is usually thought of as supplying moisture for plants, but recent research shows that it also leaches an array of substances from them. The resulting loss of mineral nutrients, sugars, growth regulators (hormones), amino acids, etc., can seriously affect crop yield, quality, nutritive value and susceptibility to insects and diseases. Even the development of autumn foliage color in many common trees and shrubs can be inhibited by prolonged rainfall.

Young plants of the dwarf form of winged euonymus (*Euonymus alatus* 'Compactus'), a common ornamental shrub noted for its brilliant red color in autumn, were grown in a greenhouse under an intermittent water mist that completely bathed the foliage for several weeks in August and September. Control plants were grown nearby in the same greenhouse, but without mist. In the latter the red autumn foliage color developed normally and the leaves dropped just as they would had they been growing outdoors. The plants then became dormant. Dormancy was broken by exposure to winter cold, and the plants grew normally the following spring.

Leaves of the misted plants did not develop the red color, but remained green and did not drop from the plant; nor did the plants become dormant. Instead, the misted plants continued to grow in the greenhouse throughout the winter and following spring, although at a somewhat slower rate than during the summer. It was also observed that whenever the misted plants were removed from under the mist, they immediately behaved as if it were autumn: growth ceased, the red pigment (anthocynanin) developed, leaves dropped and the plants became dormant, regardless of the season of the year. Thus, plants removed from the mist in January, or the following June, became completely dormant and could not be induced to leaf out and grow until subjected to cold temperature treatment. Their cycle of response to the seasons was altered by the mist treatment.

In experiments on the rooting of cuttings of the same cultivar of winged euonymus, under the same treatments, it was observed that for cuttings taken in September before plants were fully dormant, root initiation was rapid and profuse, especially when the cuttings were propagated under mist. With cuttings taken in October, rooting was difficult. Further studies made clear that intermittent mist induced the production of root-promoting substances (hormones), and that this was the primary reason why the cuttings from the misted plants rooted so much better than the non-misted cuttings.

These findings have important implications for the effect of rainfall on plant growth: Rainfall not only furnishes moisture to plants, but it may also change patterns of the seasonal response—through its effect on metabolism, influencing such important physiological processes as rooting, flowering, fruiting, leaf fall, anthocyanin production, and dormancy. ◆

Louis Buhle

Euonymus alatus

Tree Rustlers Ride Plains

B. Drummond Ayres, Jr.

From the New York Times, Nov. 10, 1971

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A NEW kind of rustler is riding the Great Plains. He slipped into Des Moines's Grandview Park the other afternoon, tipped his hat to the mothers pushing baby carriages and the old men soaking up the sun, then cut down a big black walnut tree, loaded it onto his truck and drove off. No one paid any attention. The City Parks Department is always cutting or planting. But a local sawmill paid him $700 for the logs.

Such blatant thievery and inflated lumber prices are commonplace these days in the Middle West, favored habitat of *Juglans nigra*, the black walnut.

Over the last decade or so, this proud tree, which once provided only succulent nuts and an occasional piece of firewood or sturdy furniture, has become one of the prizes of the timber business.

Increasingly, it is being used to produce veneer—not the cheap 4-by-8-foot sheets that sell for $5 and $10 at the local hardware store, but the $25 and $50 sheets that can be polished to a grainy chocolate-rich and capture the vain fancy of corporate chairmen and the discriminating eye of custom cabinetmakers.

The demand for quality walnut trees has become so great—and the supply so limited—that not only are trees being rustled but they also are being sold for almost unbelievable prices.

For example, not long ago a 100-foot-tall walnut rooted deep in the fertile prairie of north-central Indiana was auctioned off for $12,600.

Prospective buyers came all the way from West Germany and Japan, two countries that have helped deplete the supply of American black walnut trees through their huge imports. A United States company eventually cast the winning bid, safe in the economic knowledge that the mighty tree could be sliced up into hundreds of paper-thin sheets of veneer worth two or three times the original purchase price.

Not many $12,600 walnut trees still await the. saw—or the rustler. In fact, overall cuttings are down slightly because of dwindling supplies, from 28 million board feet in 1960 to 24 million feet last year. Predictably, the value of the cuttings is up, from $14-million in 1960 to $33-million last year.

But despite depleted supplies and inflated prices, foresters say there is no danger that the black walnut will become extinct. Already, groves are being planted everywhere in the interest of economy and ecology, though the black walnut is a loner at heart, preferring solitary dignity on a creek bottom to chummy anonymity in a woods.

Of the great solitary trees still standing on the Great Plains, several in Indiana are more than 200 feet tall and worth perhaps $25,000 each. They are growing on state or Federal lands, however, and therefore are not for sale.

Not that black walnut thieves would hesitate to fell them if they thought they could. Only a few months ago, tree rustlers entered Yellow River State Forest in northeastern Iowa and made off with half a dozen black walnut trees, all small but each worth at least $100.

"This sort of thing happens all over the Midwest all the time," says Gene Herkel, Iowa's chief forester. "The walnut rustler is a hard fellow to catch. He can ride around in his truck, spot a tree sitting off somewhere, cut it down quickly with one of those handy power saws, hack out a couple of good logs, hoist them onto his truck, drive over to a nearby sawmill, make a sale—and disappear. The whole thing takes less than an hour."

Which leads to the brief—all too brief—story of the Illinois farmer who returned from church one Sunday morning to find

The New York Times/Jim Carr

Remains of black walnut cut by rustlers.

a pile of limbs in his front yard where his prized walnut had once stood.

John Sester, an Illinois forester stationed at Springfield, was not surprised. He receives five to ten reports of walnut thefts every month. He says:

"The worst thing about it all is, I figure we hear about only 10 per cent or so of the cases. Some owners don't know they have valuable trees. Others know of the trees but don't keep close watch."

David Herbst, an Indiana parks official stationed at Indianapolis, hears "quite a bit" about walnut thievery, but adds:

"It's hard to keep exact tabs on it, not only because some owners don't know it's happened, but also because those complaints that do get filed seldom go farther than the local police blotter. There are mighty few convictions."

Most foresters believe that walnut rustling could be curbed if states would pass laws requiring persons selling logs to prove ownership. So far, however, few states have acted.

One that has—Missouri—has had only limited success. Its statute, requiring the seller to tell the buyer where the log was cut, has led to a practice shrewd Ozark mountaineers call "grandmaing."

Buyer—Where did you get this tree?

Seller—Over on grandma's place.

Buyer—Sold. ◆

Soil Mixes for Indoor Plants

Two new artificial soil mixes for growing a variety of tropical foliage plants have been developed at the New York State College of Agriculture at Cornell University by Russell C. Mott. Among plants that grow well in mix No. 1 are ferns, palms, geraniums, amaryllis, aphelandra, begonia, beloperone, buxus, caladium, cissus, citrus, coleus, ficus, *Hedera helix* cultivars, helxine, maranta, oxalis, pilea, sansevieria, and tolmiea.

The formula consists of sphagnum peatmoss (4 bu. screened through half-inch mesh), vermiculite No. 2 (2 bu.), medium perlite (2 bu.), and ground dolomitic limestone (3 lb.). Also, superphosphate (20 percent powdered, ¾ lb.), 10-10-10 fertilizer (1 lb.), iron sulfate (4 oz.), potassium nitrate (6 oz.), and Peter's soluble trace element mix (5.6 gm.).

The second soil mix is for those plants that usually grow on other plants for support. Such plants include bromeliads, episcia, hoya, monstera, nephthytis, pothos, and syngonium. These plants require a soil mixture with good drainage and they have the ability to withstand dry conditions between waterings, Mott said. Other types of plants that also grow well in this mix are African-violets, aglaonema, aloe, cactus, crassula, dieffenbachia, gloxinia, philodendron, and peperomia.

Ingredients for the mix are Douglas fir bark (3 bu. fine grade), medium perlite (3 bu.), sphagnum peatmoss (3 bu. shredded or screened through quarter-inch mesh), ground dolomitic limestone (3 lbs.), superphosphate (2 lbs. 20 percent powered), 10-10-10 fertilizer (1lb.), iron sulfate (4 oz.), potassium nitrate (6 oz.), and Peter's soluble trace element mix (10 gm.). ◆

How Threatening Are Poisonous Plants?

Carlton B. Lees

From HORTICULTURE, November 1971

DUE to a surge in publicity which has been given to poisonous plants in very recent years, there is a growing anxiety on the part of parents and all others who are concerned with the safety of children. Many have become frightened beyond reason. Headlines and titles such as *The Sinister Garden, The Deadly Dozen* and *Philodendron Poison* add unreasonable anxieties to a responsibility of bringing up children.

This is not to say that we should ignore the fact that certain plants can produce a toxic reaction in a child—or, for that matter, in anyone else—but rather that the whole matter should be viewed factually, without undue alarm and with a portion of old-fashioned common sense. To rid the world of wisteria or lily-of-the-valley is certainly extreme.

It is not the information about plants which can produce toxic reactions to which we object, but rather the alarming manner in which it is too often presented. Statements such as "of the 13,000 persons stricken by plant poisoning last year, some fatally, 12,000 were children" ("Touch But Don't Eat," *Family Health,* August 1971) are, at the very least, misleading. When the above statement was checked with the National Clearing House for Poison Control Centers, "some of them fatally" proved to be *one* person.

Many of the articles appear to have been written by people who have had little or no first-hand experience with plants in their everyday lives. The statement from the same *Family Health* article, "The death-dealing wild cherry looks like the harmless domestic variety," reveals that the author hardly climbed a wild cherry tree in his youth as did practically every boy I know. I well remember tasting wild cherries and promptly splitting them out. If the author had dug deeper he would have found that it is the shoots and leaves of wild cherry that are poisonous. Some authorities also report the pits as being poisonous, along with those of the cultivated cherry, as well as those of peach, apricot and plum—also some seeds such as apple and grape. Who has not at some time in his lifetime swallowed a cherry pit or two?

One booklet written by a physician carries the statement: "In 1967, 2,890 poisonings by plants occurred; 2,884 of these involved children under 5 years of age." The flaw is that the word *poison* is too often interpreted by the lay reader to mean *death*. They are not synonymous. What the author has presented—accurately—are the National Clearing House for Poison Control Centers' statistics for *toxic reaction* to the ingestion of plants. When we realize that toxic reactions—poisonings—include simple stomach upsets and minor skin rashes as well as more severe reactions, the figures become somewhat less alarming. If the author also reported the number of 1967 *fatalities* from the ingestion of plants that were reported to the same Clearing House, or had indicated the types and degrees of reactions, we would have a clearer picture.

The sad fact is that in a growing urban world not only are children denied the experience of day to day contact with plants, but they have been entrusted to a generation of parents to whom the natural landscape is strange and unknown and, therefore, often and unnecessarily feared.

We urge parents to learn about the plants in their surroundings so that they will be better informed. To be needlessly alarmed not only denies the pleasure which plants bring into everyday life, but undue alarm also can cripple a child's view of the natural world. In a time when the natural environment needs all of the understanding and care it can get we cannot afford such a generation. ♦

Musings on a Name Change

Clifton L. Merrill

From American Rock Garden Society Bulletin, July 1971

THE name of the well-beloved plant of our southeastern states, *Galax aphylla,* has now been changed to *Galax rotundifolia.* Comparison with the plant in the Linnaean collections at Burlington House in London has shown that the "*Galax aphylla*" of Linnaeus is a different plant from the one named *Galax rotundifolia* by Pursh. The latter has accordingly been designated as the type.

Among the names of well-known rock garden plants which have been changed in recent times, the following come readily to mind: *Semiaquilegia ecalcarata (Aquilegia ecalcarata), Dianthus noeanus (Acanthophyllum spinosum), Galax rotundifolia (Galax aphylla), Plagiorhegma* or *Jeffersonia* (whichever is correct), *Chamaepericlymenum canadense* (certainly a mouthful) for the euphonious *Cornus canadensis,* and *Ptilotrichum spinosum (Alyssum spinosum).* Rock gardeners have shied at *Ptilotrichum spinosum* possibly because the mind boggles at the consonantal conjunction of "Pt," looks round in alarmed disbelief, pretends it isn't there, and then goes determinedly about other duties as if the latter were intended all the while.

We tend to forget that in biology—and its branches of botany and zoology—the word "synonymy" is employed in a different sense than in common English usage. In English, a synonym is "a word having the same or nearly the same meaning in one or more senses as another"; in botany, it is "an incorrect or outmoded systemic name." True, *Galax rotundifolia (Galax aphylla)* is precise, the synonym hunched in parentheses in a sort of forlorn, alienated majesty. *Galax aphylla* (*Galax rotundifolia*) is improper as putting a deposed monarch back on a throne, a practice sometimes frowned upon by nations and always by botanists.

Casual mention of a new name can lead

The name of a choice native of the southeastern states has been changed. *Galax aphylla* has become *G. rotundifolia.*

to misadventures in communication; especially so if the nomenclatural neophyte is so recently fledged as to be recognizable only to the sponsors of the hatch. Perhaps if authors were urged to attach the immediate synonym to a newly accepted name, confusion would be avoided. Such a procedure might serve to give ballast to minds adrift on a sea of name changes. *Galax rotundifolia* tells nothing but the truth; *Galax rotundifolia (G. aphylla)* tells the whole truth to the generality of rock gardeners.

To labor the point farther, one of the exhilarants of existence for the average rock gardener-collector is a hint that there is a new (to him) species of a favorite genus. The chase is on, the dogs in full cry, one throws one's heart at a tricky fence and one's horse follows, but when the quarry is sighted, comes the denouement; the plant one has been pursuing is already growing in one's garden under a synonym. One's spirits are abraded, lassitude and boredom result.

The rules and methods adopted for the formation of botanical names in the International Code of Botanical Nomenclature are sound; names in violation must be brought into conformity. It is good that our attitude is mellowing and no longer do we overhear at a faculty tea: "Whatever happened to So and So who changed This and That to That and This?" "Oh, you mean old John—he disappeared into long term research and mercifully, was never heard of again!" Nevertheless, a few comments on name changes might be in order.

To fume about name changes is to rail against research and the discovery of truth. Scientists are the first to admit there are abuses. It would be contrary to the history of human frailties if such improprieties did not occur. But the advantages of scientific procedures, as laid down by the Code, far outweigh the tergiversations of the few.

In 1933, L. H. Bailey published a book with an inspired title, *How Plants Get Their Names*. Not "got," mind you, but "get." What is inherent in the Bailey caption?

Truth is relative; not absolute; is what is agreed upon at a particular moment in time by informed people as being consistent with the known facts. As factual knowledge grows, comes the need for new concepts of truth. We identify and define such additions where plants are concerned in Latin binomials. So the process goes on. Names are changed, are changing, will change.

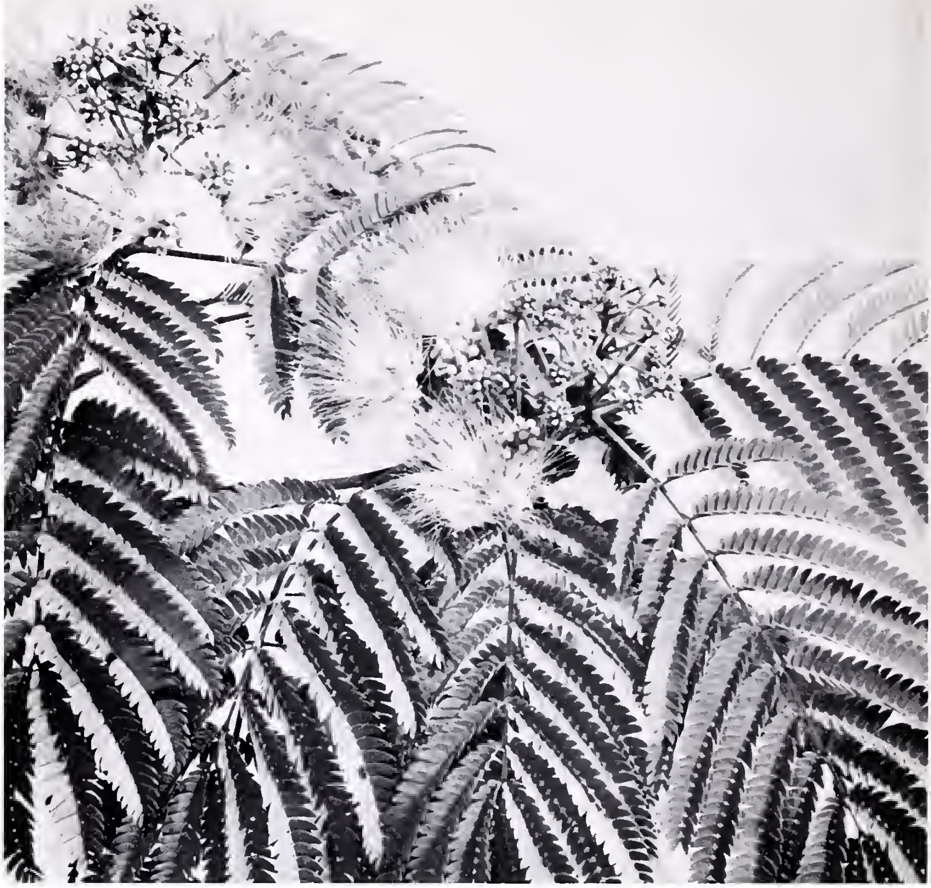
And so, grumble as we may, and gibe as we will, names will continue to change and be "hard" to pronounce, the latter fact being to a respectable elderly gentleman with uncertain dentures, such as the present writer, just another example of the "slings and arrows of outrageous fortune."

New names must be recorded; these are scattered in scientific journals and proceedings, authoritative books, floras, etc., spread over many countries, written in different languages. Unfortunately, there is not a regular authoritative reporting of name changes readily available to all botanists and plant lovers. Surely we should bear this in mind when we criticize the editors and writers for violating the rules of name priority. "Seek and ye shall find" is true of heavenly, but, not necessarily, of nomenclatural salvation. Usually one discovers the changes by sheer accident, like encountering an old school fellow: "Fancy meeting you after all these years. I thought we were both dead!"

Perhaps the type change as between *Galax aphylla* and *Galax rotundifolia* might be summed up in deathless doggerel:

The nuptials of the latter are consummated,
And the marriage of the former is Renovated. ◆

Further information on plant nomenclature will be found in "The Changing Names of Plants" by Harold W. Rickett, PLANTS & GARDENS, Winter 1968-69, page 54. A few copies of this back issue are available from the Secretary of Publications, Brooklyn Botanic Garden, at $1.50 postpaid.



Louis Buhle

Pink powder-puffs of flowers in mid-summer above lacy foliage of tropical appearance are the glory of the hardy silk-tree (*Albizzia julibrissin* 'Ernest Wilson'). Seedlings will show some variation in flower color and possibly hardiness.

Asclepias tuberosa

Ampelopsis brevipedunculata

Seeds Available to Members

A LIMITED quantity of seed of the following plants will be available to *members* of the Brooklyn Botanic Garden in autumn, 1972. When making requests, send stamped, self-addressed envelope to Frederick McGourty, Jr. at the Botanic Garden. For others who wish to avail themselves of this offering and of additional privileges of Membership, information on joining the Garden is available from Mrs. Norman Free at the Garden. Regular membership dues are $15 yearly.

Hardy silk-tree (*Albizzia julibrissin rosea*). Tree to 25 ft., taller in the South, often shrubby in the North. Pink powderpuffs of flowers in mid-summer. Lacy foliage of tropical appearance. Drought tolerant, and thriving under urban conditions. Expect slight variation in flower color and perhaps hardiness. Protect seedlings the first several winters. Often called "mimosa." The varietal name has recently been changed to 'Ernest Wilson.' Zone 6-5 (Arnold Arboretum map).

Porcelain vine (*Ampelopis brevipedunculata*). A vigorous climber, increasing its height by tendrils. Grown mainly for its berries, which are colored lilac to turquoise as they ripen over a long period in autumn. Donald Wyman considers the fruits unequaled in beauty among woody vines. Cedar waxwings and robins think a lot of them, too. The vines are reliably winter hardy through Zone 4.

Butterflyweed (*Asclepias tuberosa*). Handsome, 2-3 foot-tall herbaceous perennial, native from New Hampshire to Arizona. Vivid orange flowers in midsummer. Tolerant of dry soil; performs best in full sun. Don't expect flowers the first year or two. Transplant with care, for the plant develops a taproot. Seed pods similar to milkweed and useful in dried arrangements. One of the most attractive wildflowers, and a good border plant as well. The seeds that will be distributed are a gift of Elizabeth and Catherine Van Brunt. Zone 3. ♦

New Law Protects Breeders of Plants Propagated by Seed

From American Nurseryman, June, 1971

A NEW law gives breeders of certain new plants protection from having their "inventions" exploited by others. The new law is known as the Plant Variety Protection Act and is being administered by the U.S. Department of Agriculture. Specifically, it covers varieties of plants which are reproduced sexually (through seeds). In this group are virtually all garden vegetables, crops such as wheat and soybeans, flowers and various trees and shrubs. The law does not cover okra, celery, peppers, tomatoes, carrots, cucumbers and hybrids of any kind.[1]

Breeders of new and novel plants which are reproduced nonsexually, by budding or grafting, have been eligible for protection under the U.S. Patent Act since 1930. This latter group of plants includes roses and fruit trees.

Within the Grain Division of USDA's Consumer and Marketing Service is the new Plant Variety Protection Office, which handles requests for certificates of protection from plant breeders. The office staff includes experts, called examiners, who search through reference material to make sure a variety is actually novel and thus eligible for a certificate of protection. The examiners make their decisions based on these findings. A decision by the examiner may be appealed by the plant breeder to the Secretary of Agriculture and to the Federal courts.

The law lists three qualifications for a "novel variety."

First. the variety must be distinct and differ from all known prior varieties by at least one characteristic.

Second, the variety must be uniform. Any variations in the plants must be describable and predictable.

Third, the variety must be stable from generation to generation, remaining unchanged in its essential and distinctive characteristics.

Once a certificate of plant variety protection is issued, the holder of that certificate may use the Federal courts to protect his rights. Infringement of the certificate holder's rights will occur, for example, if a second party, without authority, sells the novel variety, exports it out of the United States, or sexually multiplies the variety as a step to selling it. The protection is valid for 17 years.

Among the benefits likely to result from the new law will be an increase in plant breeding by private breeders outside the government. Since protection was not previously available to breeders of new varieties of these plants, few private companies could afford the expense necessary to develop a new variety.

Government agencies may eventually give up developing new varieties and turn to more basic research.

Application forms and other information may be obtained from the Plant Variety Protection Office, Grain Division, Consumer and Marketing Service, U.S. Department of Agriculture, 6505 Belcrest Road, Hyattsville, Md. 20782. ◆

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[1] As defined in the rules and regulations under the Federal Seed Act, a hybrid is the first generation seed of a cross produced by controlling the pollination and by combining (1) two or more inbred lines; (2) one inbred or single cross with an open-pollinated variety, or (3) two varieties or species, except open-pollinated varieties of corn.

The second generation and subsequent generations from such crosses shall not be regarded as hybrids. However, if a particular plant type is selected from subsequent generations until it breeds "true" as to uniformity and stability and meets the definition of a variety as defined in section 41(a) in the Plant Variety Protection Act, it would be considered a variety as a result of hybridization.

1971 BOOKS WORTH NOTING

In the Library of the Brooklyn Botanic Garden

City Gardening

Garden in Your House by Ernesta Drinker Ballard. Harper & Row Publishers, New York. $6.95.

Welcome revision of a standard house plant guide.

The Small Garden Book by R. Milton Carleton. The Macmillan Company, New York. $7.95

Ideas for owners of the quarter-acre estate. The book's strong points occur when the author discusses planning, tools, soils and lawns.

Gardening Indoors Under Lights by Frederick H. and Jacqueline L. Kranz. Viking Press, New York. $7.95

Revision of a book published in 1957. A well-rounded account on a subject of increasing interest to many people.

The Citrus Seed Grower's Indoor How-to Book by Hazel Perper. Dodd, Mead & Company, New York. $3.00

Atavism in the apartment house.

Cucumbers in a Flowerpot by Alice Skelsey. Workman Publishing Company, New York. $2.45

Spiral paperback on what wonders the city farmer can perform in his apartment. Imaginative.

Flower Arranging

The Miniature Flower Arrangement Book by Margaret and Godfrey Best. Charles Scribner's Sons, New York. $9.95

An idea book of photographs with brief text. From Great Britain.

Flowers, Space & Motion by Helen Van Pelt Wilson. Simon & Schuster, Inc., New York. $7.95

Arrangements for the 1970's. There are 97 photographs.

Gardening

Plants are like People by Jerry Baker. Nash Publishing, Los Angeles. $6.95

Chatty, light-hearted account of garden procedures by a television personality and columnist.

The Southern Garden by Ben Arthur Davis. J. B. Lippincott Company, Philadelphia & New York. $5.95

Welcome addition to the rather small list of regional gardening books.

Container Gardening Indoors and Out by Jack Kramer. Doubleday & Company, Inc., Garden City, New York. $6.95

Mr. Kramer is a prolific writer, and this is one of his better efforts.

The Well-Tempered Garden by Christopher Lloyd. E. P. Dutton & Co., Inc., New York. $10.00

An unusually well-written English garden primer. Not all of the information applies to American conditions, but the book has more substance than most of its kind.

The White-Flower-Farm Garden Book by Amos Pettingill. Alfred A. Knopf, New York. $10.00

Expanded and modified version of the charming catalog of a well-known nursery specializing in herbaceous perennials.

Gardens Are for Eating by Stanley Schuler. The Macmillan Company, New York. $9.95

How to grow common and uncommon vegetables. Recommended varieties. There are separate chapters on nut and fruit trees (including warm-climate ones), berry plants and herbs.

Organic Gardening Without Poisons by Hamilton Tyler. Van Nostrand Reinhold Company, New York. $7.50

Better-than-average treatment of a currently popular subject. A source list of weapons (ladybugs, mantis egg cases, pyrethrum, etc.) is included.

Miscellaneous

The Closing Circle by Barry Commoner. Alfred A. Knopf, New York. $6.95

A provocative, intensely argued analysis of the environmental crisis and what should be done. The author, now a prominent spokesman for the new meta-science, is an alumnus of the Children's Garden at the Brooklyn Botanic Garden.

Stalking the Good Life by Euell Gibbons. David McKay Company, Inc., New York. $5.95.

A personal account by one who has stalked the wild asparagus. Mr. Gibbons has foraged in the countryside, along the seashore and even in New York's Central Park. Beguiling bedside reading.

Exotic Plants by Julia F. Morton. Western Publishing Company, New York. $1.25 paper.

One of the best in the Golden Press series. Northern gardeners will want it in their pockets when visiting Florida and southern California.

Plants Poisonous to People in Florida and Other Warm Areas by Julia F. Morton. Hurricane House, Miami. $10.95 cloth bound, $5.95 spiral bound.

Some of the common mild-climate plants have toxic qualities, too. Fine photographs.

Water, The Wonder of Life by Rutherford Platt. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. $8.95

Fine account of one of nature's most important substances. Mr. Platt's sources are eclectic and his books are always enjoyable to read.

Plant Groups

Betty Crocker's Kitchen Gardens by Mary Mason Campbell. Universal Publishing, Inc., New York. $6.95.

Herb buff and backyard epicure will find much useful information here. The illustrations by Tasha Tudor are charming.

Ferns to Know and Grow by F. Gordon Foster. Hawthorn Books, Inc., New York. $7.95.

Revised, enlarged edition of the helpful *The Gardener's Fern Book.*

Orchids You Can Grow by Harry Britton Logan. Hawthorn Books, Inc., New York. $12.95.

Fine introduction to a complex and challenging group of plants. Numerous photographs.

The Complete Book of Garden Bulbs by Marc Reynolds and William L. Meachem. Funk & Wagnalls, New York. $10.00

Summer-flowering bulbs are included in this expansion of a 1967 book, *The Garden Bulbs of Spring.*

Cacti and Succulents Indoors and Outdoors by Martha Van Ness. Van Nostrand Reinhold Company, New York. $7.95.

How-to information for the new cactus buff. A well-rounded and well-illustrated guide.

Books in Series

Annuals by James Underwood Crockett and the editors of Time-Life Books. Time-Life Books, New York. $6.95

The first of a series of garden books by this large publisher. As with most Time-Life products, there are many fine photographs. Attractive watercolors by Allianora Rosse. Robert Tomson, George Kalmbacher and Edmond Moulin of the Brooklyn Botanic Garden were among the consultants for this book. Mr. Crockett, the author of the series, is perhaps best known to gardeners for his greenhouse articles in HORTICULTURE Magazine. *Other* recent titles in the series: *Bulbs, Evergreens, Flowering House Plants, Landscape Gardening,* and *Roses.*

The Hidden Life of Flowers by J. M. Guilcher and R. H. Noailles. Sterling Nature Series, Sterling Publishing Co., Inc. $3.69.

Close-up photographs of flower parts, with explanatory text. Nature has its own art, particularly in detail, and it is unfortunate that Mr. Noailles' splendid pictures suffer in this adaptation of a French book published in 1950.

Other books in this series: *A Fern is Born* (same authors and price), with somewhat better photographic reproduction; *How to Enjoy Your Weeds,* by Audrey Wynne Hatfield. The latter book, written by an English woman, provides interesting background on some of nature's most successful plants.

Hanging Gardens by Jack Kramer. Charles Scribner's Sons, New York. $5.95 clothbound, $2.95 paperback.

Basket plants and how to grow them. Other new titles by the author in this series are *Miniature Plants Indoors and Out* and *Water Gardening* (same prices).

Technical Books

Phloem Transport in Plants by Alden S. Crafts and Carl E. Crisp. W. H. Freeman and Company, San Francisco. $12.50.

Plant Speciation by Verne Grant. Columbia University Press, New York. $15.00

How a species comes about. Chapters on hybrid complexes, too.

Diseases of Forest and Shade Trees of the United States by George Hepting. U.S. Dept. of Agriculture, Forest Service Agriculture Handbook No. 386. Available for $4.00 from Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402.

Comprehensive manual of special interest to foresters and fruit tree growers. Some ornamental trees from other lands are included.

Wild Flowers of the United States: The Northwestern States. Volume 5, in 2 parts, by Harold William Rickett. $57.50.

The latest in a mammoth project undertaken by the New York Botanical Garden. Numerous photographs, lengthy text.

Dover Reprints

Available from Dover Publications, Inc., 11 East 2nd St., Mineola, N.Y. 11501.

An Illustrated Flora of the Northern United States and Canada by Nathaniel Lord Britton and Hon. Addison Brown. Second Edition revised and enlarged, 1913. Three volumes $5.00 each.

American Wildlife & Plants, A Guide to Wildlife Food Habits by Alexander C. Martin, Herbert S. Zim and Arnold L. Nelson. Originally published in 1951. $3.50.

Flora of the Prairies and Plains of Central North America by Per Axel Rydberg. Originally published in 1932. Two volumes, $5.00 each. ◆

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Tree Ring Dating Upsets Carbon 14 Estimates of Prehistory Chronology

Ancient specimens of the bristlecone pine *(Pinus aristata)*, a species native to the American West, are now regarded as the world's oldest living things. Counts of annual rings on individual trees indicate ages of more than 4,500 years and estimates on the age of others range up to about 7,000 years. In venerability these trees clearly antedate the oldest known giant-sequoias of California. At the Laboratory of Tree-Ring Research at the University of Arizona Charles W. Ferguson has established a continuous absolute tree ring chronology reaching back about 8,000 years.

In order to check actual ring-count with carbon 14 dating, Ferguson sent wood samples to three different laboratories (the Universities of Arizona, California at San Diego, and Pennsylvania). The independent determinations agree fairly well with one another. Now Colin Renfrew reports on the significance of these findings as related to archeology *(Scientific American,* October, 1971). Hans E. Suess of the U. of Calif. at San Diego has analyzed the data and finds that absolute age of the wood and carbon 14 determinations agree rather well back to 1500 B.C. Going back another 1,000 years, however, the differences become progressively larger and amount to as much as 700 years by 2500 B.C.; the carbon 14 dates are all too young.

Applying this information to prehistory means that some ancient sites (based on carbon 14 dating) are as much as 700 or more years older than they were previously thought to be. Suess offers a calibration "table" that makes it possible to convert carbon 14 years into calendar years. The traditional idea of dating prehistoric developments according to the theory of cultural diffusion also appears to be no longer tenable. ◆

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(*Errata:* In the Handbook for Spring, TREE AND SHRUB FORMS—THEIR LANDSCAPE USE, the drawings and photographs on pages 47-54 should have been credited to Michael E. Pirich.)

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